Contents

1.0 Update Information

1.1 Future Update Bulletins 9

2.0 Description

2.1 Service Manual 11
2.2 Advisory Information 11
2.3 Servicing Policy 11
2.4 Warranty 12
2.5 Precautions 13
2.6 Cautions 13
2.7 Warnings 14
2.8 General 15
2.9 Framework 15
2.10 Gas Supply Module 15
2.11 Sliding Fresh Gas Outlet, Oxygen Flush Valve and 50cm H_2O Patient Safety Valve Module 15
2.12 Rotameter Unit 16
2.13 Flow Control Valves 16
2.14 Selectatec® Vaporiser Back Bar 17
2.15 System ON-OFF Switch 17
2.16 Fitting Vaporisers 18
2.17 Fitting Accessory Equipment 18
A Fitting Monitor Restraining Straps 18
B Fitting of General Accessories 20
C Ventilator Mount 20
D Scavenge Assembly 20
2.18 Connecting Medical Supplies 21
A General 21
B Cylinder Supplies 21
C Piped Medical Gas Supplies 22
2.19 System Tests 23
A Preparation 23
B Gas Supply Checks 23

3.0 Specification

3.1 Physical 25
A Dimensions 25
B Shelves 25
C Weight 25
3.2 Pneumatics 25
A Flowmeters - Standard Calibrated Ranges 25
B Vaporiser Back Bar 25
C Sliding Fresh Gas Outlet, Oxygen Flush Valve and 50cm H_2O Patient Safety Valve 26
D Internal Pneumatic Circuitry 27
E Oxygen Failure Alarm 27
F Nitrous Oxide and Air Failure Alarms 27
G Regulators 27
H Yoke Blocks 27
I Gas Power Outlet 27

© Copyright 1993 – Iss/Rev A/0 –

4.0 Theory of Operation - Pneumatics

4.1 A Power On 29
B Oxygen Failure Alarm 29
C Gas Supply System 30
D oxygen Flush 30
E Safety Valve (50cm H_2O) 30
F Selectatec® Vaporiser Manifold 30
G Low Oxygen Monitor (GMS125) 30
H Alarms 31

5.0 Theory of Operation - Electronic

5.1 GMS125 Software Description 35
A Gas Analysis 35
B Alarms 36
C Solenoids 37
D Option Switches 37
5.2 Electronics Hardware 38
A Power Supplies 38
B Pneumatics Interface 38
C Watchdog Timer 39
D Ultrasonic Analysis 39

6.0 Service Procedure

6.1 Service Schedules 65
A General 65
B Service Procedure 65
6.2 Pipeline Gas Hose 66
6.3 Frame and Castors 66
6.4 Gas Supply System 66
6.5 Gas Supply System - Testing and Calibration 66
A Test Configuration 66
B High Pressure Leak Test - Pipeline and Cylinder Non-return Valves and Gas Supply Block Pressure Relief Valve 67
C Gas Supply Block Dynamic and Static Output Test 67
6.6 Oxygen Gas Block System Leak Test 69
6.7 On/Off Rotary Switch 69
6.8 PS1 Set Pressure 69
6.9 Reserve O_2 Regulator Set Pressure 69
6.10 Power Outlet Flow Test 69
6.11 N_2O Gas Block system Leak Test 70
6.12 Vaporiser Manifold Mechanical Checks 70
6.13 Pressure Relief Valve Setting Check 70
6.14 Leak Test (Flowmeters to FGO) 71
6.15 Port Valve Servicing 72
6.16 Fault Finding Guide 73
6.17 O_2 Flush Valve Test 74
6.18 Oxygen Analyser Test 75
6.19 PS2 Set Pressure 76
6.20 Air Gas Block System Leak Test 76

6.21 PS3 Set Pressure 76
6.22 O_2 Failure Operational Check 77
6.23 AC & DC Power Failure (SOL1) 77
6.24 GMS125 Test Procedure 77
6.25 Electrical Safety 78

7.0 Spare Parts List

7.1 Spare parts list 80

8.0 General

8.1 Diagnostic/Fault Finding 109
8.2 Preventative Maintenance 112
8.3 Anaesthesia System Inspection Form 113
8.4 Patient Breathing System 114
8.5 Sterilisation 115
8.6 Pre-Operative Checkout and System Shutdown 115
Optional Note 1 117
Optional Note 2 117
Optional Note 3 118

© Copyright 1993 – Iss/Rev A/0 –

Illustrations

Chapter 2

Fig 2.1 Example of design of flowmeter module 16
Fig 2.2 Profile of oxygen flow control knob 16
Fig 2.3 GEM™9100, On-Off Switch 17
Fig 2.4 Fitting Selectatec® Vaporisers 19
Fig 2.5 Fitting Securing Clip 19
Fig 2.6 Securing Larger Items of Equipment 20
Fig 2.7 Securing Smaller Items of Equipment 20
Fig 2.8 Gas Pack Back View 22
Fig 2.9 Isometric of Gas Pack Near View 22

Chapter 3

Fig 3.1 Sliding FGO - Oxygen Flush and 50cmH_2O Patient Valve 26

Chapter 4

Pneumatic Circuit Diagram 33

Chapter 5

GMS125 Low Oxygen Monitor Block Diagram 41
GMS125 Front Panel Circuit Diagram 43
GMS125 Microprocessor Circuit 45
GMS125 Power Supply Circuit 47
GMS125 Interface Circuits 49
GMS125 Transducer Circuit 51
GMS125 Spare Parts Circuit 53

Chapter 6

Fig 6.1 Testing Gas Supply Systems 57
Fig 6.2 Testing Gas Supply System 58
Fig 6.3 Test Blocks 60
Fig 6.4 Pressure Relief Valve Leak Test Configuration 60
Fig 6.5 Port Valve 62
Fig 6.6 Locking Lever Retention Spring Renewal 63
Fig 6.7 Oxygen Flush Valve Test 64
Fig 6.8 Power Outlet Flow Test 65
Fig 6.9 Oxygen Analyser Test Configuration 66

Tables

Table 6.1 Oxygen Analyser List 65
Table 6.2 Air/O_2 Table 65

Chapter 7

Front Elevation GEM™9100 71
Side Elevation GEM™9100 73
Back Elevation GEM™9100 75
Rotameter Block Right Side Elevation 77
Rotameter Block Front Elevation 77
Rotameter Block Left Side Elevation 77
Flow Control Valve 79
Back Bar Front Elevation 81
Fresh Gas Outlet Assembly (FGO) 83
Auxiliary Oxygen Outlet 85
Scavenging Interface Assembly 87
Flowmeter Scavenge 89
Power Board Assembly 91

Photographs

Gas Pack (Front View) 93
Gas Pack (Rear View) 93
Gas Pack (Top View) 93

1.0 Amendment History

Page/Section	Iss/Rev	Date	Amendment Comments
All	A/0	22/3/93	New Issue

© Copyright 1993 – Iss/Rev A/0 –

OHMEDA

THE BOC GROUP

T.E.C. BULLETIN

For internal use only No 441 **Date of Issue 2 November, 1994**

GMS 125 Monitor

The GMS 125 monitor has now been in use since 1991. We now have a reasonable supply of data to make some assessment on performance so far. B. Tyers has written a review of some of the most common faults based upon data obtained in the repair of monitors that have been returned to Tulla. Please see attached.

Please note that battery life is rated to last 36 months in the GEM 9100. You should be replacing batteries now. The P.M. procedure as detailed in the service manual calls for a 3 yearly replacement.

Failures of any product is an undesirable, much less in an Anaesthetic machine. It would seem that most of the bugs in earlier monitors have now been addressed through upgrades as detailed in the attached report. Consequently the failure rate under warranty should now start to fall. Further, clarification by B. Tyers on the operation of the Monitor should also assist in reducing units being returned to Tulla under the premise that they are faulty when indeed they are good units.

Should units fail in the field and the cause may not be clear then please call myself or B. Tyers, we may be able to assist in the diagnosis and thus improve the "Strike Rate" of only faulty units being returned to Tulla.

Should you need further information or clarification please do not hesitate to call me

Kind Regards

GREG DOCKAR

TECHNICAL AND REGULATOR AFFAIRS MANAGER.

ISSUED BY THE TECHNICAL and ENGINEERING CENTRE (TEC) HEAD OFFICE.

between extremes of temperature while fully operational. After the E.S.S., which takes about 18 hours, the modules are fully tested for compliance with specification. The E.S.S. procedure was developed by the USAF and can be statistically shown to improve the reliability of equipment exposed to it by a factor of about 10.

When servicing a GEM please record the serial number of the machine- it's on the frame just below the instrument shelf- as well as the serial number of the GMS module. If you have replaced the module also record the serial number of the new module.

Notwithstanding the possible fault mentioned above, there is an increasing likelihood that a Low Battery alarm may be caused by a low battery!
If the module is well warmed up and the battery terminal voltage on charge is above 13.4 volt but there is still a Low Battery alarm there is a very good chance that the battery is not holding its charge and must be replaced.
The recommended battery is the Yuasa NP7-12, but any equivalent sealed-electrolyte, lead-acid battery could be used. Yuasa claim that their battery should typically give 36 months useful life in this type of service. Naturally some batteries will be better than this and some worse. We recommend that the battery be changed every 24 months. There are now GEM's in the field well over 2 years old.

Conservatively, about 25% of the GMS monitors returned for repair are found to be operating correctly. The following functional description should enable you to perform sufficient testing on a suspect monitor before condemning it.

To perform the testing you will need Oxygen and Nitrous Oxide gas supplies and preferably Air as well; also a voltmeter to check the battery voltage. The battery is located underneath the working surface which will have to be removed to gain access.

Theory Of Operation
The monitor uses an ultrasonic technique to measure the velocity of sound in a chamber through which passes the gas mixture exiting from the top of the rotameter block. Every 0.5 second an ultrasonic pulse is transmitted by a transducer mounted at the top of the chamber; the time it takes the pulse to be returned to the same transducer as an echo from the bottom plate is a measure of sound velocity. The volume of the chamber is about 0.6 litre, and it will therefore take a short time for a change in mixture to be registered as at least 0.6 litre of the new mixture is needed to replace the old. For example, at a total flow of 2 lpm, you have to allow at least 18 seconds for the reading to settle. The response time also depends on the magnitude of the change and the degree of mixing of the old mixture with the new. As a general guide, allow at least 3 times the theoretical replacement time; in the above example allow about 60 seconds.

There may be some comments about the slow response to a change in gas percentages. It should be pointed out, though, that the reading will always accurately reflect the gas mixture in the sample chamber which is downstream of the rotameter block and is, therefore, closer to the patient.

The technique is only suitable for determining the percentage of a known gas in a mixture with one other known gas. In our case we have elected to calibrate the

instrument for Oxygen and Nitrous Oxide, or Oxygen and Medical Air. The method is robust, inherently accurate and drift free; it is not expected that there will be any need for routine calibration (and this has been borne out by our experience to date). The only (2 reported) instances we have had of incorrect readings have been due to water vapour in the (supposedly dry) Medical Air supply which gave a reading error of several percent. The instrument is fully compensated for changes in temperature.

If there is Air in the chamber when the monitor is first turned on, there will be no display and an alarm because the system is looking for Nitrous Oxide and finding a velocity which is outside the expected range. Similarly, if the Air mode is selected when there is a Nitrous Oxide mixture in the chamber there will be a 'no echo' (EF3) alarm and a blanked display.

When in the Nitrous Oxide mode, the Low Oxygen Alarm triggers at 23% exactly and does not reset until the reading rises to 26%. There is an Audible alarm for the Low Oxygen condition but there is no change of state of the Nitrous Oxide Solenoid. Five seconds after the reading falls to 18%, or lower, the Nitrous Oxide solenoid releases and the supply of Nitrous Oxide to the patient is shut off. If there is Oxygen flow the percentage of Oxygen will increase; 15 seconds after the reading reaches 19%, or above, the Nitrous Oxide solenoid will reactivate and Nitrous Oxide will again be available to the patient circuit. Note the time delays involved in the operation of the solenoid. Depending on the flow rate, the percentage reading shown on the display when the solenoid operates may be quite different to the 18/19% trigger points.

When the GEM machine is not in use it should always be left connected to the mains supply so that the battery is kept charged. If the mains is not connected there will be a flashing red light on the front panel. (A well charged battery will operate the Mains Off light for over a month.)

With the monitor switched OFF and the mains connected the battery terminal voltage should be about 13.8 volt. With the monitor ON this will drop to about 13.5 volt. Every 4 minutes the monitor turns off its internal battery charger for 4 seconds, leaving the monitor to operate solely from the battery so that the battery condition can be assessed. During this time a good battery will drop to about 12.6 volt. The low battery alarm trigger point is set to between 12.0 volt and 12.2 volt. Normally a deteriorating battery which has just failed this test will still power the monitor, without mains assistance, for about 30 minutes.

There have been a couple of reports of odd readings occurring when the system has been subjected to extremely rapid changes in flow rate. An extremely sudden change in pressure will temporarily upset the ultrasonic transducer and there is nothing we can do about that. It only takes a couple of seconds to stabilise, however, and the transducer suffers no permanent damage.

Calibration and alarms tests

Select Nitrous Oxide; on the Rotameter bank get 2 lpm Oxygen and 2 lpm Nitrous; after stabilising, the readout should be 50%. Reduce the Oxygen flow to 1 lpm- the readout should now go to 33%. On Nitrous Oxide the acceptable tolerance is +/- 2% (of full scale).

Drop the Oxygen flow to 0.5 lpm; as the reading comes down to 20% the Low Oxygen alarm should come on at 23%. Reduce the Oxygen flow further to 0.4 lpm; as the reading falls the Nitrous solenoid should release 5 seconds after the reading reaches 18%- the Nitrous backlight should go off. Now increase the Oxygen flow back to 1 lpm and observe that a) the Low Oxygen alarm goes out when the reading reaches 26% and b) the Nitrous supply is restored 15 seconds after the reading reaches 19%. Select Air; with 2 lpm Oxygen and 2 lpm Air the reading should stabilise to 60%. On Air the acceptable tolerance is +/- 3%.

If you have any questions which have not been answered here or in the Service Manual please contact me directly at Tullamarine- 03 3390 273 or fax 03 338 6094.

Bob Tyers.
October 14, 1994

12.4
11.8
9.5 –
LOW ALARM AT 12.5
100 m/m

2.0 Description

2.1 Service Manual

This manual includes a general description of the GEM™9100 Anaesthetic Machine and the instructions required in order to set up, operate, and service the machine.

Modifications, variations, or alterations made to factory settings, recommended checking procedures, or practices, may affect the warranty liability of CIG Health Care. It is recommended that the nearest CIG Health Care sales or service office be contacted for advice should there be any doubt as to the suitability of non-standard accessories or should any modifications be desired.

2.2 Advisory Information

There are Warnings, Cautions, and Notes throughout this manual to draw attention to possible hazards or adverse conditions which may occur if the instructions provided are not followed.

Warnings are used to draw attention to a condition which can endanger either the patient or the operator.

Cautions are used to draw attention to a condition which can result in damage to the equipment.

Notes are used to draw attention to important information or instructions.

Special attention must be paid to each **Warning** and **Caution**. A comprehensive list of all the Cautions and Warnings which appear in this Manual is provided in Preface 1 and 2.

2.3 Servicing Policy

Servicing procedures for this product must be performed by CIG Health Care trained personnel in accordance with written instructions provided by CIG Health Care.

WARNING: Only persons trained to repair and/or service the GEM™9100 should attempt to repair and/or service the machine or void the warranty. An improper repair and/or service can result in patient injury.

Detailed repair information is included in this Service Manual.

Warranty repair and service procedures must be performed either by a CIG Health Care Service Representative or at the nearest CIG Health Care Service Centre.

If the equipment is to be transported to the nearest CIG Health Care Service Centre package it securely in its original packaging if possible for protection and ship it prepaid. Enclose the following items as applicable.

1. A letter describing in detail any difficulties experienced with the equipment.
2. Warranty information, such as a copy of the invoice or other applicable documentation.
3. Purchase order number to cover repair of equipment not under warranty.
4. Ship to and invoicing information.
5. The name and telephone/fax number of the person to contact for functional questions.

Other than when CIG Health Care's warranty is applicable, repairs are made at CIG Health Care's current list price for replacement part(s) plus a reasonable labour charge.

2.4 Warranty

This product is sold by CIG Health Care under the warranties set forth in the following paragraphs. Such warranties are extended only with respect to the purchase of this product either directly from CIG Health Care or from a CIG Health Care Authorised Distributor as new merchandise. Other than authorised CIG Health Care Distributor warranties are extended to the first buyer of the product only for purposes other than resale.

For a period of twelve (12) months from the date of original delivery to the Buyer or to the Buyer's order, but in no event for a period of more than two (2) years from the date of original delivery by CIG Health Care to a CIG Health Care Authorised Dealer, this product, except for expendable parts, is warranted to be free from functional defects in materials and workmanship. It conforms to the description of the product contained in the O&M Manual and accompanying labels and/or inserts, PROVIDED THAT the Product is properly operated under conditions of normal use, that regular periodic maintenance and service is performed and that any replacements or repairs are made in accordance with the instructions provided. This same warranty is made for a period of thirty (30) days with respect to the expendable parts.

These warranties shall not apply if the product has been repaired other than by CIG Health Care trained personnel or other than in accordance with written instructions provided by CIG Health Care, or altered by anyone other than CIG Health Care, or if the product has been subjected to abuse, misuse, negligence or accident.

CIG Health Care's sole and exclusive obligation and the Buyer's sole and exclusive remedy under the above warranties is limited to repairing or replacing, free of charge at CIG Health Care's option, a product which is reported by telephone to the nearest local CIG Health Care Sales/Service Centre or to a CIG Health Care Authorised Distributor as being defective, and which, if so advised by CIG Health Care, is thereafter returned to the designated CIG Health Care Service Centre Unit during normal business hours together with a statement of the observed deficiency, not later than seven (7) days after the expiration date of the applicable warranty, transportation charges prepaid, and which, upon CIG Health Care's examination, is found not to conform with the above warranties.

CIG Health Care shall not otherwise be liable for any damages including but not limited to incidental damages, consequential damages, or special damages.

There are no express or implied warranties which extend beyond the warranties previously set forth. CIG Health Care makes no warranty of merchantability or fitness for a particular purpose with respect to the product or parts thereof.

2.5 Precautions

There are a number of precautions which must be observed when either setting up, operating, maintaining or servicing the equipment described in this manual. These precautions are designated either as a **Warning** which indicates a potentially life threatening situation, or as a **Caution** which indicates a condition which can lead to equipment damage or malfunction.

The following Warnings and Cautions are used in various places throughout this manual to alert the reader to the possibility that potentially hazardous and/or damaging conditions can occur if the precautions are not observed:

2.6 Cautions

Avoid using excessive torque when closing flow control valves otherwise a leaking valve can result.

The ON/OFF switch must be turned OFF when the anaesthesia system is not in use in order to minimise the possibility of depleting the oxygen supply.

Do not exceed the maximum load of 22 Kg specified for the top shelf or 11 kg specified for the mid shelf. An excessive load can damage the system.

Do not use wrenches on the cylinder yoke tee handles; using excessive force can damage the threads.

Always use a yoke plug and cylinder gasket to seal an unused yoke. Yoke check valves alone may not provide a leak-free seal.

Use only one bodok seal per yoke. If more than one seal is used it can cause a leakage of cylinder gas.

Open cylinder valves slowly to minimise the possibility of causing any damage to the associated pressure regulators or gauges.

Normal patient flows can be turned ON or OFF by means of the ON/OFF switch, but the flowmeter unit can be damaged by the sudden onset of gas if the ON/OFF switch is turned ON with a flow control valve set fully counter-clockwise.

Ensure that all gas flow control valves are turned fully clockwise to their minimum flow stops before the system ON/OFF switch is turned ON. The flowmeter unit can be damaged by a sudden surge of gas when the system ON/OFF switch is turned ON.

In the event of sterilising rubber components with ethylene oxide they must be quarantined in a well-ventilated area to allow dissipation of residual ethylene oxide gas absorbed by the rubber. In some cases aeration periods of seven days or more may be required. Aeration time can be decreased when special aeration devices are used. Follow the steriliser manufacturer's recommendations for specific aeration periods required.

The oxygen flow control valve incorporates a left-hand thread and must be turned clockwise in order to remove it.

2.7 Warnings

Only personnel trained by CIG Health Care should attempt to repair and/or service a GEM™9100 Series Anaesthesia System and it must be repaired and/or serviced only in accordance with written instructions provided by CIG Health Care. Failure to follow the written instructions provided can result in patient injury.

The GEM™9100 Series Anaesthesia System is restricted to use with non-flammable anaesthetic agents in order to minimise the possibility of an explosion.

Never oil or grease any anaesthesia or oxygen equipment unless the lubricant used is made and approved for this type of service. In general, oils and greases oxidise readily and, in the presence of oxygen, they burn violently. Either Fomblin UT 18 or Vac Kote* is the oxygen service lubricant recommended for use.

Do not connect the scavenging valve(s) directly to a vacuum source. The vacuum may removed required gases from the patient circuit. Any time that nitrous oxide is used it must be properly scavenged to minimise pollution.

Do not leave any gas reserve cylinders open if the pipeline supply is in use and the system ON/OFF switch is turned to ON. Pressures from both supplies may become equal and, if simultaneously used, cylinder supplies could be depleted, leaving an insufficient reserve supply in case of pipeline failure.

Unqualified personnel must not undertake or attempt the following procedures. An improper repair or service can result in patient injury.

Never cover anaesthesia equipment with any type of fabric or plastic covering. Removing the cover may cause static electricity with the possibility of a resultant fire or explosion.

Before disconnecting any gas supply tube or electrical lead ensure that it incorporates an identification sleeve and, if necessary, fit an additional temporary identification to facilitate correct reconnection. Remove the temporary identification when the reconnection is completed. Failing to reconnect a supply tube or an electrical connection correctly can cause an incorrect gas delivery and possibly patient injury.

*Trademark, Ball Corporation

2.8 General

The GEM™9100 Anaesthesia System includes electronic and pneumatic circuitry, a three gas rotameter module and two position Selectatec® vaporiser backbar in order to control, distribute, and mix medical gases. With the optional Ohmeda Tec® Series Vaporisers fitted, this will then allow the gas and agent mixture to be delivered to the common gas outlet.

Note: Selectatec® and Tec® are registered trade names for Ohmeda and the BOC Group.

2.9 Framework

The all stainless steel framework is complemented by twin needle roller bearing castors for easy movement. The front castors incorporate a single foot-operated brake bar which is used to lock the rotation and swivel. An accessory mounting rail is fitted to three sides of the work surface area for convenient mounting of accessories..

2.10 Gas Supply Module

The GEM™9100 has a removable pneumatic gas supply Module which incorporates the following components:

- Pressure regulators complete with delivery pressure safety valves.
- Cylinder contents gauges.
- Pipeline pressure gauges.
- Pin indexed yokes for Oxygen, Nitrous Oxide, and Air cylinders.
- Pipeline gas inlet for Oxygen, Nitrous Oxide, and Air, fitted with SISS safety sleeve connections.
- Ventilator drive gas outlet (oxygen is standard).
- Colour coded, diameter indexed nylon pneumatic circuitry.
- Gas solenoid valves for Oxygen, Nitrous Oxide, Air and a power failure shistle.
- Pressure switches for Oxygen, Nitrous Oxide, and Air.
- Oxygen gas failure reservoir.
- Oxygen fail alarm.
- Back-up rechargeable battery

2.11 Sliding Fresh Gas Outlet, Oxygen Flush Valve and 50cmH_2O Patient Safety Valve Module

A sliding combination Fresh Gas Outlet, Oxygen Flush Valve, and 50 cm H_2O patient safety valve has been provided. This module can be mounted on one of the rails that are provided on the three sides of the main work surface area. The design allows for the module to slide over the full length of the rail. The valve controls on "Oxygen Flush" and "Safety Valve Over-ride" are protected, to prevent accidental activation. The fresh gas outlet is a coaxial 15mm female/22 mm male fitting with a latching bayonet. Inlets for Oxygen and mixed gases are diameter indexed and are connected to main pneumatic gas module by flexible tubing.

2.12 Rotameter Unit

Rotameter flow tubes are mounted in the same sequence as the gas supply gauges. Each flow tube meters the flow of one only gas. (Refer Fig.2.1)

A preferential oxygen flow system is incorporated in the rotameter unit to ensure that oxygen is delivered into the mixture downstream of all other gases (Refer Fig.2.1)

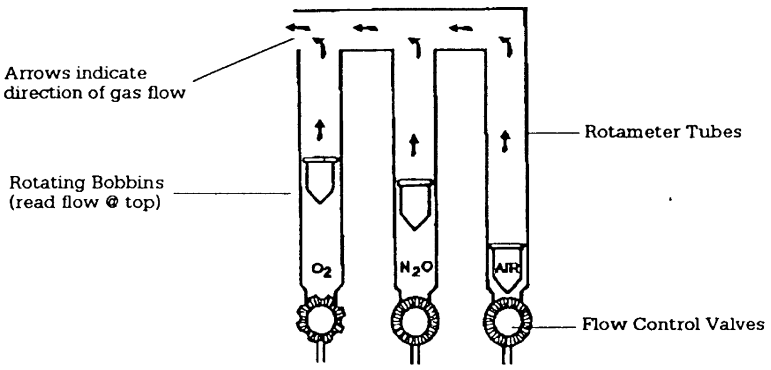


Fig 2.1 Example of design of flowmeter module with the oxygen flowmeter and control on the left and oxygen entering the common gas manifold last

Each rotameter tube is backlit when the gas it measures is selected and is available.

The rotameter tubes are indexed to ensure non-interchangeability.

2.13 Flow Control Valves

The gas supply has a flow control mounted below its rotameter. The flow control's control knob for each gas is coded by the gas colour and symbol. In addition the oxygen control knob is fluted for easy identification.

Control knobs are recessed and protected for safety.

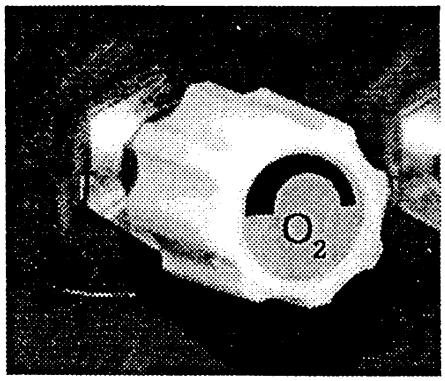


Fig 2.2 Profile of oxygen flow control knob.

Each flow control valve knob must be turned fully anti-clockwise to obtain maximum flow or fully clockwise to shut off the flow.

For all gases, turn flow control valves anti-clockwise and check that bobbin spins freely at all flows (particularly at low flows) and also that the rise and fall of bobbin is free.

Warning: Low oxygen mixtures can be delivered from the system, but both visual and audible warning will occur.

Caution: Avoid excessive torque when turning flow control valves to the fully closed position, as the seat may be damage.

Note: It is strongly recommended that an oxygen analyser be used at all times in the patient breathing circuit in order to verify the oxygen concentration in the gas delivered to the patient.

2.14 Selectatec® Vaporiser Back Bar

The GEM™9100 has a two Selectatec® Vaporiser Back Bar fitted as standard which can accommodate either one or two Ohmeda Tec® 3, 4 or 5 Vaporisers to be fitted.

Tec® 4 and 5 Vaporisers incorporate an interlock system which is designed to ensure that only one vaporiser at a time can be turned on. However this feature does not operate if one position has a Tec® 3 mounted.

Warning: Do not use a vaporiser which is either visibly out of line on the back bar or can be lifted off the back bar when the locking lever is in the locked position.

Note: Selectatec® and Tec® are registered trademarks of Ohmeda.

2.15 System ON-OFF Switch

The system ON-OFF switch on GEM™9100 controls the Oxygen, Nitrous Oxide, and Air supply to the rotameter module via the flow control valves. The GMS125 monitor is also activated when the system is in the ON position.

Note: The system ON-OFF switch does not control the gas supply to the oxygen flush valve, the ventilator outlets or the oxygen auxiliary gas outlet. These are active regardless of the position of the ON-OFF switch, providing that oxygen gas supply either from pipeline or cylinders is available.

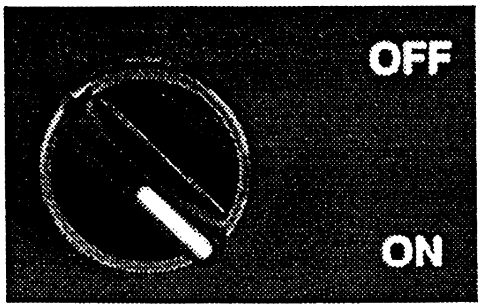


Fig 2.3 GEM™9100, On-Off Switch

© Copyright 1993 – Iss/Rev A/0 –

2.16 Fitting Vaporisers (Fig. 2.4)

A maximum of two vaporisers can be fitted. If any vaporiser position is not occupied the gas flow is diverted through the Selectatec® Back Bar.

Warning: Do not use a vaporiser which is either visibly out of line on the Back Bar or if it can be lifted off the back bar when the locking lever is in the locked position

1. Ensure that the protective dust caps are removed from the vaporiser inlet and outlet gas ports.

2. Ensure that the Back Bar Manifold "O" Rings are fitted and that there is no foreign matter present on mating surfaces.

3. Remove any damaged "O" Rings, taking care not to damage the port, and fit new "O" Rings.

4. Position the vaporiser onto the back bar so that both vaporiser ports engage with the back bar port valves, and then turn the vaporiser locking lever fully clockwise to lock the vaporiser onto the back bar .

5. Refer to the Vaporiser Operating Manual for the relevant vaporiser operating instructions.

Note: The GEM™9100 can be used with Tec® 3, 4, and 5 Vaporisers. In order to prevent simultaneous delivery of more than one anaesthetic agent the Tec® 4 and 5 Series Vaporisers have incorporated an internal mechanical safety interlock device which ensures that only **ONE** vaporiser can be turned **ON** at any time. Tec® 3 series Vaporisers **DO NOT** have this safety feature.

6. With the Tec® 4 and 5 Vaporisers, if it is necessary to turn OFF, the one IN USE before the other vaporiser can be turned ON.

2.17 Fitting Accessory Equipment

A Fitting Monitor Restraining Straps

Caution: Do not exceed the maximum load of 20Kg. specified for Standard Monitor Shelf.

1. Place equipment in the required position on the Monitor Shelf.

2. Place two clips through the slot immediately adjacent to one side of the required position of the equipment as illustrated on Fig.2.5

3. When larger items of equipment are being fitted, secure the buckle end of the securing strap to the two clips as illustrated on Fig.2.6 and then position the equipment onto the shelf immediately adjacent to the clips.

4. Fit two more clips to the shelf on the other side of the equipment, pass the free end of the strap through the clips and tighten the strap to secure the equipment in position.

Fig 2.4 Fitting Selectatec® Vaporisers

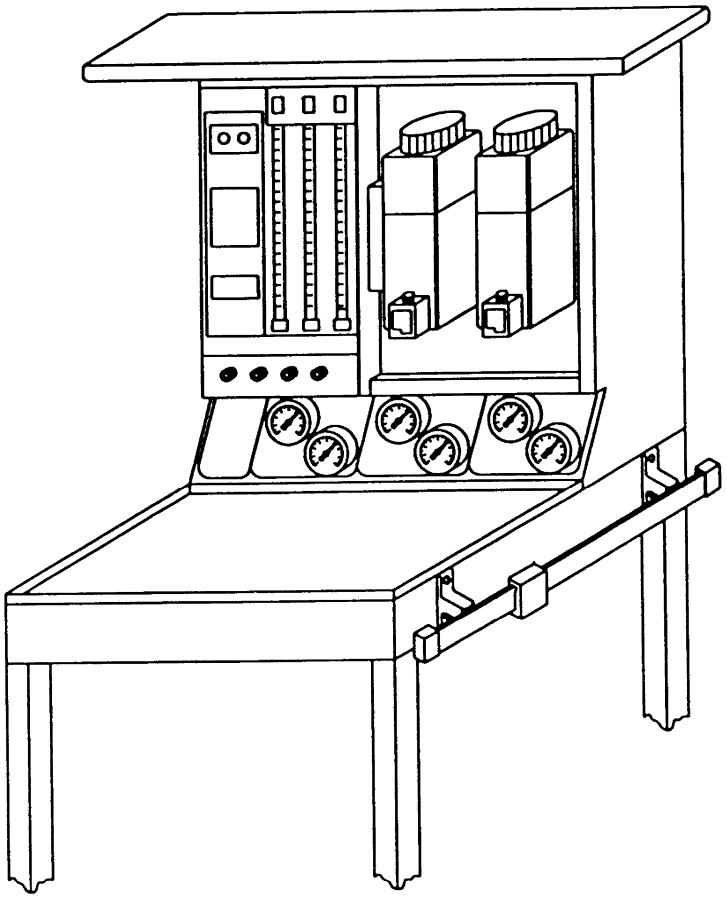
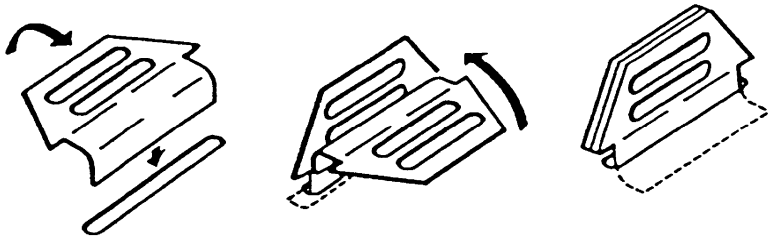


Fig 2.5 Fitting Securing Clip



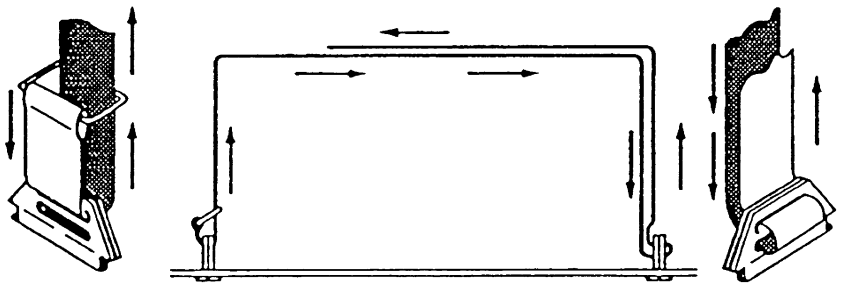


Fig 2.6 Securing Larger Items of Equipment.

5. When smaller items of equipment are being fitted, secure the buckle end of the securing strap to the two clips as illustrated on Fig.2.7, position the equipment onto the shelf immediately adjacent to the slips and then fit the second pair of clips.

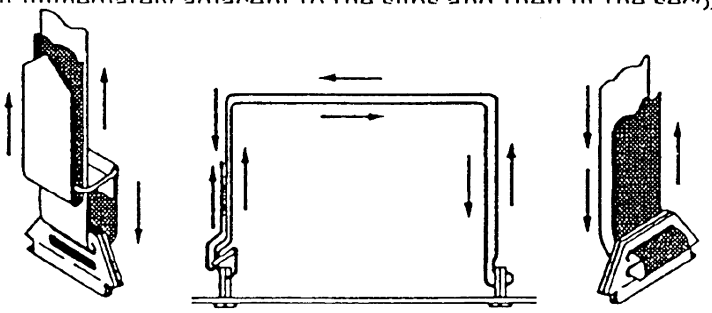


Fig 2.7 Securing Smaller Items of Equipment.

6. Pass the free end of the strap through the clips and back through the buckle and then tighten the strap to secure the equipment in position.

7. Connect the equipment to the gas and/or electrical supplies as required.

B Fitting of General Accessories

A range of accessories is available to mount onto the multerail. These accessories all clip on using standard multerail clamps and can be locked in place by the wing nut on the multerail clamp.

C Ventilator Mount

A ventilator mount, suitable for the Ohmeda 7000 series ventilators, secures to the mounting pin provided on the left hand side of the GEM™9100 frame. The mounting pin can also be secured to the right hand side for alternate mounting of the ventilator.

D Scavenge Assembly

A purpose built scavenge assembly is available. It is designed in two parts; a flowmeter is mounted high on the machine to allow for maximum visibility and an interface resevior is mounted on the rear of the machine. Both parts are removable for cleaning.

2.18 Connecting Medical Gas Supplies

A General

All gas supply connectors are colour coded and labelled. Each high pressure hose is fitted with a non-interchangeable quick connect probe or gas specific sleeve indexed safety system screw-on handwheel. These features comply with Australian Standard AS.2896 (1986) and are designed to minimise the possibility of connecting an incorrect pipeline gas supply.

It is recommended that cylinders are turned OFF when the anaesthesia system is not in use or when a hospital pipeline supply is connected to the gas pneumatic module.

Caution: Always use a yoke plug and Bodok seal on any unused yoke.

B Cylinder Supplies

Note: Check valves alone may not provide a leak-free seal. A yoke plug will also prevent the ingress of dust and foreign material.

1. Ensure that the anaesthesia system ON-OFF switch is in the OFF position.

2. If fitting a new cylinder, remove the cylinder valve protective seal and then momentarily open the cylinder valve, thus forcing out any foreign material which may have entered the cylinder valve outlet.

3. Remove the Bodok seals from their plastic bag and fit to the yoke inlet nipple, taking care as not to damage them.

Caution: Use only one Bodok seal per yoke. If more than one bodok seal is used, a leak may occur.

Warning: Ensure that hands are clean and free from any form of oil or grease when handling bodok seals.

4. Unscrew the cylinder yoke tee screw.

5. Position the cylinder valve post into the cylinder yoke block, ensuring that it is fully engaged so that the cylinder valve outlet fully engages the yoke block inlet. Yoke index pins must also fully engage the corresponding pin index holes on the cylinder valve post.

6. Secure the cylinder valve in position by screwing the cylinder yoke tee clockwise.

7. Disconnect any gas powered accessory from gas supply outlets on GEM™9100 for the duration of the test detailed in instruction 8.

Note: Only C sized cylinders which can accomodate external hand wheels are recommended. Some cylinders with intergrated handwheels only may not allow the handwheels on the GEM™9100 to function.

Caution: Open cylinder valve SLOWLY to help avoid any damage to the associated pneumatic components.

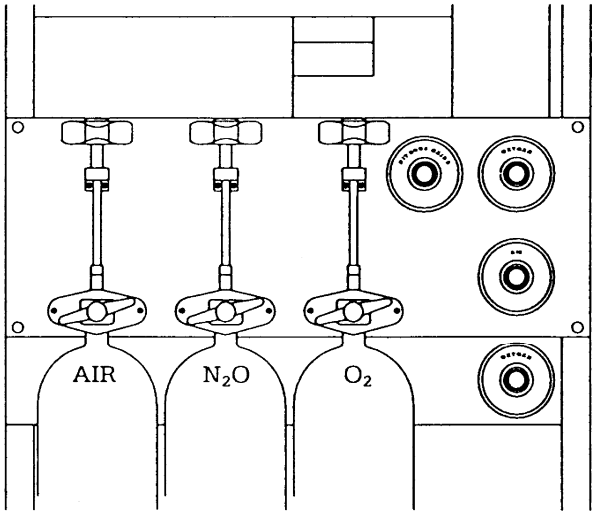


Fig 2.8 Gas Pack Back View

8. Open one gas cylinder valve at a time and then fully close it. Note the cylinder pressure gauge position contents (indicator needle) and check that the indication does NOT decrease. Reconnect any gas powered accessory disconnected in Instruction 7.

9. Repeat the procedure described in Instructions 7 and 8 for each gas as required.

C Piped Medical Gas Supplies

1. Ensure that the high pressure pipeline hose assembly is fitted with a gas-specific, female screw-on (SISS) handwheel at the machine end and a gas-specific quick connect probe or a gas-specific sleeve indexed safety sleeved screw-on handwheel at the other end. (Ref. AS.2896-(1986)).

2. Connect the pipeline female (SISS) handwheel connection to the GEM™9100 male (SISS) inlet on the pneumatic module ensuring that the connection is hand-tight.

3. Connect the gas-specific probe/handwheel to the hospital medical gas supply system.

4. Ensure that each pressure gauge indicates pipeline pressure and then repeat the procedure for each gas supply as required.

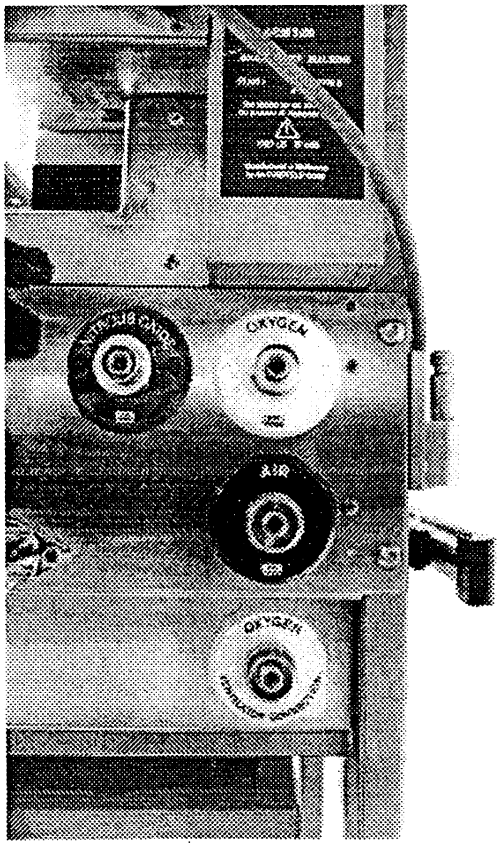


Fig 2.9 Rear view of Gas Pack showing pipeline inlets and O_2 ventilator outlet

2.19 Alarm System Tests

Warning: Do not attempt to use the GEM™9100 to perform a clinical procedure without first ensuring that the complete system, including all accessory equipment, is operating correctly.

Warning: The following test procedures must be performed using the same medical gas supply outlets/cylinders that will be used during the clinical procedure.

A Preparation

1. Ensure that each flow control valve is set to the fully **OFF** or closed position (fully clockwise).

2. With the ON-OFF switch in the OFF condition, check that there is no gas flow to any of the rotameter tubes, but there is an oxygen supply available at both the Oxygen Flush Valve, the ventilator outlet and the oxygen gas auxiliary outlet at the front of the pneumatics module..

B Alarm System Checks

Note: Gases should be turned off when the machine is not in use. Check that all gases are OFF before turning ON the machine.

1. Turn on the machine at the main ON-OFF switch at the front of the low O_2 monitor.

   After the self-test of all lights and audible alarm, the oxygen failure alarm should be initiated, both visible and audible.

2. Push "Mute". The audible alarm should stop and the light continue to flash. The alarm will resound after 15 seconds.
   2.1 Turn ON the Nitrous Oxide supply and check that it flows through the correct rotameter.

Full check out procedure is detailed in the System Pre-operation Check Out and Shutdown section.

© Copyright 1993 – Iss/Rev A/0 –

D Internal Pneumatic Circuitry

Diameter and colour coded flexible nylon tubing is used internally to prevent the accidental cross-connection of gases.

	Colour	Diameter OD
Oxygen	White	6mm
Nitrous Oxide	Blue	5mm
Air	Black	8mm
Mixed Gases	Red	1/4"

E Oxygen Failure Alarm

Failure of the oxygen supply is detected and alarmed by an electronic sensing system. An independent pneumatic interlock ensures that Nitrous Oxide is cut-off if Oxygen fails.

A visual and audible alarm will be activated when the Oxygen pressure in the machine drops below nominal 207 kPa.

In the event of Oxygen failure, an emergency 0.8L reservoir will continue to supply oxygen at half the normal flow untill exhausted.

F Nitrous Oxide and Air Failure Alarms

Visual and audible alarms will activate when source Nitrous Oxide or Air pressure decreases to a nominal 240 kPa.

G Regulators

GEM™9100 has one regulator for each gas.

	Model	Max. Inlet Pressure	Set Outlet	Safety Valve
Oxygen	CIGWELD Series 'O'	16,000kPa	320kPa static	800kPa
Nitrous Oxide	CIGWELD Series 'O'	16,000kPa	320kPa static	800kPa
Air	CIGWELD Series 'O'	16,000kPa	320kPa static	800kPa

H Yoke

Pin indexed yokes are provided (1 x Oxygen, 1 x Nitrous Oxide, 1 x Air). Pin indexing is required by AS2473.A 34 Micron (max). Inlet filter is fitted.

I Gas Power Outlet

Two oxygen gas power outlets are supplied as standard. One is for ventilator connection and the other is an auxillary oxygen supply. Both are fitted with self sealing SIS screw on connections.

© Copyright 1993 – Iss/Rev A/0 –

	Static	Dynamic @ 100 Lpm	
		Ventilator	Auxillary
Pipeline Supply	420/380 kPa	320kPa	180 kPa
Cylinder Supply	320 kPa	200 kPa	180 kPa

4.0 Theory of Operation

4.1 Pneumatic

A. Power On

When the Electro-Pneumatic switch is turned ON the Low Oxygen Monitor will run a Power On Self Test (POST). Once POST has been completed SOL1 and SOL2, will be energised by the monitor's micro-processor. At the same time power to the Oxygen and Nitrous Oxide back light lamps will be supplied by the monitor.

At power ON the micro-processor is programmed to default to Oxygen and Nitrous Oxide gas selection. If Air is selected, the micro-processor will de-energise SOL2, and energise SOL3. At the same time the Nitrous Oxide lamps will be extinguished and the Air lamps will light indicating that Air has been selected and that a pressure of 220kPa (±20kPa) is present in the Air pipeline within the machine.

B. Oxygen Failure Alarm

Oxygen is the preferential gas which is maintained to the patient delivery system during oxygen gas supply failure from the internal reservoir. When either wall or cylinder supply pressure falls below 220kPa, pressure switch (PS1) will open. This will cause the micro-processor in the Low Oxygen Monitor to initiate the following:

1. De-energise solenoid SOL2 (Hence removing N_2O from ROT2).
2. Turn OFF the power drivers to the lamps which provide back lighting to the Nitrous Oxide rotameter tube.
3. Turn ON the O_2 fail indicator and sound the O_2 failure alarm.

Note: If Air is selected it is not deactivated.

De-energising SOL2 ensures that any N_2O up or down stream of the N_2O rotameter fine adjustment valve will be vented to atmosphere resulting in no Nitrous Oxide being delivered into the patient circuit.

When the pressure on the up stream side of the one way valve (V8) falls below that of the down stream side, V8 will shut off. This will ensure that the oxygen left in the oxygen reserve tank will be used to supply fresh gas into the patient circuit for approximately 45 seconds at 1 LPM flowrate.

Regulator REG4 will operate to maintain a pressure of 175kPa in the Oxygen circuit and feed gas from the oxygen reservoir tank into the oxygen gas supply circuit. Under normal operating conditions, V8 and V7 act together to ensure that gas is fed into the oxygen reservoir tank from the main oxygen supply. The pressure in the reservoir tank will be approximately equal to the gas supply system.

C. Gas Supply System

Two sources of supply are available for each gas, which is wall supply and emergency back up cylinder supply. Under normal conditions gas is selected from the wall outlet which then passes through a non return valve being either V4, V5, or V6. Gas will then pass through to the appropriate section of the gas pack.

When oxygen is connected from the wall supply V1 will close off and V4 will open allowing oxygen under 400kPa pressure (from wall supply) to enter the machine's pneumatic circuit. This pressure can be measured at the Oxygen test port. When the emergency oxygen supply is in use, REG1 will regulate the pressure to 320kPa with V4 closed off and V1 open allowing oxygen under 320kPa pressure to enter the pneumatic circuit.

D. Oxygen Flush

When the Oxygen flush valve is activated, Oxygen is fed from the outlet of the Oxygen gas supply system directly to the Fresh Gas Outlet (FGO). Gas will flow for as long as the button is pressed, a momentary back pressure affect will be experienced by the rotameter's dropping and then coming back to their original settings once the Oxygen flush button has been depressed.

E. Safety Valve (50cm H_2O)

The safety valve is set to operate at 50cm H_2O (Nominal). The valve will start to operate at approximately 40cm H_2O and will be fully open at 60cm H_2O. The override feature allows the operator to increase patient airway pressures as need be. It is also used when the patient circuit is flushed with oxygen.

F. Selectatec® Vaporiser Manifold

Mixed gas from the rotameter bank is passed through the Selectatec® manifold. The gas will then pass through the appropriate vaporiser at patient airway pressure picking up the desired anaesthetic agent at the concentration indicated on the dial setting. The gas will then pass to the FGO and into the patient circuit.

G. Low Oxygen Monitor (GMS125)

The GMS125 is housed in a separate module. It contains a sensor tube, a printed circuit board, a front panel assembly and a mains transformer.

One end of the sensor tube houses an ultrasonic transducer. This periodically transmits a short burst of pulses into the tube, then reverts to a receiver to detect the echo returning after reflection from the opposite end. The transmit time is an accurate indication of the velocity of sound in the gas mixture in the tube.

The velocity of sound varies with the molecular density of a gas and can thus be used to determine the percentage of Oxygen in a mixture with one other (known) gas.

Management of the measurement sequence is handled by the microprocessor which also organises the sequencing and logical verification of the operation of the gas solenoid valves and pressure switches.

When gas pressure is detected by a pressure switch, the appropriate rotameter backlight will be illuminated.

There is a digital display of Oxygen percentage. If the percentage in a mixture with Nitrous Oxide goes below 23% an alarm will be initiated. This is a high priority alarm - the audible component can only be muted twice for 15 seconds and after that will continue unabated until the alarm condition is cleared. (There is 3% hysteresis so the percentage must rise to 28 before the alarm condition clears).

The electronics are normally powered from the mains; a rechargeable battery, which is accommodated in the pneumatics module, is supplied to continue operation of the system in the event of a mains failure. There is a Mains Off alarm. While the mains is ON, the battery is automatically being charged.

When a faulty battery is detected, a Battery Fail alarm is initiated. If no action is taken to recharge (or replace) the battery at that time, the battery will eventually be disconnected by a self protection circuit.

H. Alarms

There are three modes of audible alarm sounds to indicate levels of urgency.

1. A top priority alarm pulses on for 200mS and off for 200mS three times then pauses for 1.0S before repeating the cycle. It can only be muted twice for 15S. This level of priority is only applied to the Low Oxygen concentration alarm which operates in a Nitrous Oxide with Oxygen mixture.

2. The medium priority alarm pulses on for 200mS and off for 200mS twice and pauses for 1.0S before repeating the cycle. It can be continually muted for 30S at a time. It is applied to the Failed condition, i.e. low pressure at the pressure switch.

3. A low priority alarm pulses on and off once each for 200mS before a pause of 1.0S and recycling. It is used for the System Error alarm, the Nitrous Oxide and Air Fail alarms, and the Battery Fail alarm.

The system Error alarm is a single indicator of several alarm conditions which are outside the control of the operator:

EF1 N_2O selected, Air detected.
EF2 Air selected, N_2O detected.
EF3 No ECHO.
EF4 Air and N_2O simultaneously selected.

© Copyright 1993 – Iss/Rev A/0 –

5.0 Theory of Operation - Electronic

5.1 GMS125 Software Description

Refer to the Block Diagram for details of the hardware which the software controls. Refer also to the Alarm Chart which details the conditions which initiate alarms.

The three basic functions of the machine which are controlled by software are:

1. Gas analysis.
2. Alarms (as a result of monitoring the activities around the circuit).
3. Solenoid control (both in normal operation and as a result of an alarm condition).

Note that:

1. The rotameter lights are controlled directly by hardware from the pressure switches - not from the software.
2. The power fail alarm, which is an Oxygen powered whistle, and the Mains OFF alarm, operate independently of the software.
3. Similarly the Watchdog timer alarm operates when there is a failure of the microprocessor or associated circuitry; it cannot be software driven.

A Gas Analysis

Every 500mS a pulse is generated to initiate the measurement process (P270). As a result of this a burst of ultrasonic energy is transmitted along the sensor tube and an echo is received at the same transducer after a time delay which is dependent upon the velocity of sound in the gas mixture and which is measured by a 16 bit binary counter whose clock input is taken from TO on the microprocessor.

The gain of the echo amplifier is controlled such that it is increased, by P263 going low, for mixtures of oxygen in nitrous oxide between 85% and 55%, and further by P263 also going low below 55%. There is a hysteresis of +/-2% on the gain switching points.

The 16 bit count is used to calculate the percentage oxygen as a 3 digit BCD format and this is output as short bursts of serial data from P272; P273 is used to clock the data into the shift register in the MM5451 seven segment driver on the front panel PCB.

The temperature correction factor is required for the calculation, and this is derived from the thermistor sensor which is mounted on the sensor tube. The thermistor voltage is converted to 8 bit binary format, input to the microprocessor at ports P10 to P17, and used in the algorithm to calculate the percentage oxygen in the gas.

The inputs at ports P342 (nitrous oxide) and P343 (air) are also required to tell the program whether nitrous oxide or air is in the sample chamber with oxygen and therefore which constants and calculation method are applicable. If the calculated result is outside the expected range, or if there is no discernible echo, the display will be blanked and a SYSTEM ERROR alarm initiated. An exception to this is when a new gas selection has just been made, in which case the display is blanked but the alarm is inhibited for 60 seconds, or until a valid reading is obtained, to allow time for the old mixture to be purged from the sample chamber.

B Alarms

Visual alarms are accompanied by audible alarm tones which suggest degrees of urgency. Two tones are used and they are gated by two ports from the microcomputer; P363 for the high tone and P362 for the low tone. For urgent alarms (Low Oxygen and Oxygen Failure) the tone sequence is High/Low/High; for less urgent alarms Low/High, and for low priority alarms High/Low.

Most audible alarms can be muted for a short period by pushing the Mute button. The normal mute time is 30 seconds, after which the audible alarm resumes if the alarm condition persists. However for high priority alarms the mute time is 15 seconds and a Low Oxygen alarm can be muted only twice, after which only clearing the alarm condition can quieten it.

If the oxygen percentage in a mixture with nitrous oxide goes to 23 or below there will be a LOW OXYGEN alarm and the reading has to go up to 26 or higher for that alarm to be cancelled. If the reading continues to fall, 5 seconds after it reaches 18, the nitrous oxide solenoid will be turned OFF; 15 seconds after it goes over 19, the nitrous oxide solenoid will be turned ON again. This function operates independently of the LOW OXYGEN alarm and it is possible to have a condition where the alarm has been cleared but the solenoid is still turned OFF because it is less than 15 seconds since the display exceeded 19.

In the air/oxygen mode there is a LOW OXYGEN alarm if the % oxygen is 18 or lower.

The Mains Off alarm is basically a hardware alarm, except that there is a brief audible alarm when the disconnection of the mains is first detected. Thereafter there is no audible alarm, and the flashing light is hardware controlled.

Every 4 minutes, a 4 second pulse is outputted from P360 to reduce the output voltage of the regulator U16. During this period the circuit is running only from the battery and it is thus possible to assess the condition of the battery. A Battery Fail alarm will be detected at P350 (from U19b). If the voltage is less than 11.8 vdc, the alarm will be latched and not be retested for another 255 seconds (4 minutes 15 seconds).

Refer to the Alarm Chart for further details of the alarm conditions, the applicable mute sequences and audible alarm priorities.

C Solenoids

The Air solenoid is turned ON when Air is selected and OFF when Nitrous Oxide is selected.

Similarly the Nitrous Oxide solenoid is turned ON when Nitrous Oxide is selected and OFF when Air is selected. However, it is also turned OFF when the oxygen percentage in a mixture with nitrous oxide has been less than 18 for 5 seconds or when the oxygen supply has failed. There is no nitrous oxide alarm under these circumstances because the nitrous oxide has been turned OFF deliberately.

The whistle solenoid is not controlled by the software.

D Option Switches

These three switches can be used for diagnosis and verification of correct operation.

1. P371 (O) Normal 3 gas machine
   (1) Special instruction set for 2 gases only i.e. no air.
2. P372 (O) Normal
   (1) Special stress cycle; runs during environmental stress testing.
3. P373 (O) Normal
   (1) Debug mode: In this special diagnostic mode the digital display shows 5 consecutive numbers for 1 second each followed by a 1 second blank - a 6 second cycle. The first two numbers correspond to the actual count of the 16 bit binary counter. The first display is the decimal equivalent of the most significant 8 bits and should be multiplied by 256 and added to the second number to obtain the total count. The third number is the A-D Converter output i.e. the temperature. The fourth and fifth numbers are the temperature corrected time delay, again with the most significant byte first. In Debug mode the continuous scanning of the sample chamber is halted, so only the first sequence of numbers is necessarily relevant.

5.2 Electronics - Hardware

Refer to the Block Diagram, to the Circuit Diagram and also to the Software Description.

(The Block Diagram is representational only and does not purport to convey anything more than the general electronics functional blocks and the scheme of their interconnection. The Circuit Diagram contains all the detail of the electronic wiring.

A Power Supplies

Incoming mains is transformed down to 15 volts, rectified and regulated by U16 whose output is nominally set (by R13) to 13.8 volt (no load). The battery is connected directly to this and is continuously charged so long as the mains is connected. If the mains is turned OFF or accidentally disconnected, a Mains Fail alarm is initiated by D8 and Q15. There is a brief audible burst (software) and a continuous flashing light on the front panel driven by the U20 oscillator, which has a 100:1 duty cycle to conserve battery life. (It is recommended that the mains be left connected all the time, even when the machine is not in use).

The microprocessor and associated circuitry is powered from a 5 volt regulator, U23 and the rotameter lights and solenoids are supplied from Q11 at 11 volts. There is also a 2.5 volt supply, Q8, for the 7-segment displays on the front panel.

Battery Management

At regular intervals (approximately every 4 minutes) the microprocessor briefly turns on Q9, thus reducing the regulator output by about 20%. If the battery is well charged and able to supply the circuit the voltage drop will not be significant. If the voltage drops by a large amount (to about 11.8 volt) the low voltage detector (U19b) will be tripped and a Low Battery alarm condition created. This alarm will not be reassessed until the next sample period (4 minutes later). If during battery-only operation, the battery voltage goes so low (about 10.8 volt) that the battery itself may be damaged by further discharge, the circuit will be automatically disconnected by relay RL1 via detector U19a. In this situation, with no mains supply and the battery disconnected for protection, the GMS125 will no longer be functional. If mains is reconnected the monitor will function normally except that a LOW BATTERY alarm will exist until the battery is sufficiently recharged. The monitor will similarly function if the battery is disconnected.

B Pneumatics Interface

In the pneumatics module are mounted three gas solenoid valves, three gas pressure switches and the battery. Referring to the pneumatic diagram will show that there is one pressure switch ON each of the incoming gases - Oxygen, Nitrous Oxide and Air. The switches are normally closed and open when there is sufficient gas pressure.

The "whistle" solenoid valve is normally operated as soon as the ON/OFF switch is turned ON; if it is not operated Oxygen will pass through it and operate the whistle. If there is a complete power failure (both mains and battery) the whistle will sound to alert the operator to the fact. The other two solenoids control the supply of Nitrous Oxide and Air to the rotameter bank. Note that there is no solenoid which controls the supply of Oxygen to the rotameter. However the ON/OFF switch, mounted at the bottom of the front panel of the monitor is a combination electric/pneumatic device and cuts off the supply of Oxygen to the rotameter at the same time as it turns off the electrical supply.

C Watchdog Timer

A continuous sequence of low-going pulses from port P241 will keep the input of U7a from going low and thus the output from U8b from going high. If there is a fault with the microcomputer and the pulses cease, the microprocessor will receive a reset signal from U8c, which will also cause the whistle solenoid to be released and the whistle to sound. There will be a System Error alarm via OR gate U8d; a System Error alarm may also be caused by a high at port P240 from the microcomputer.

D Ultrasonic Analysis

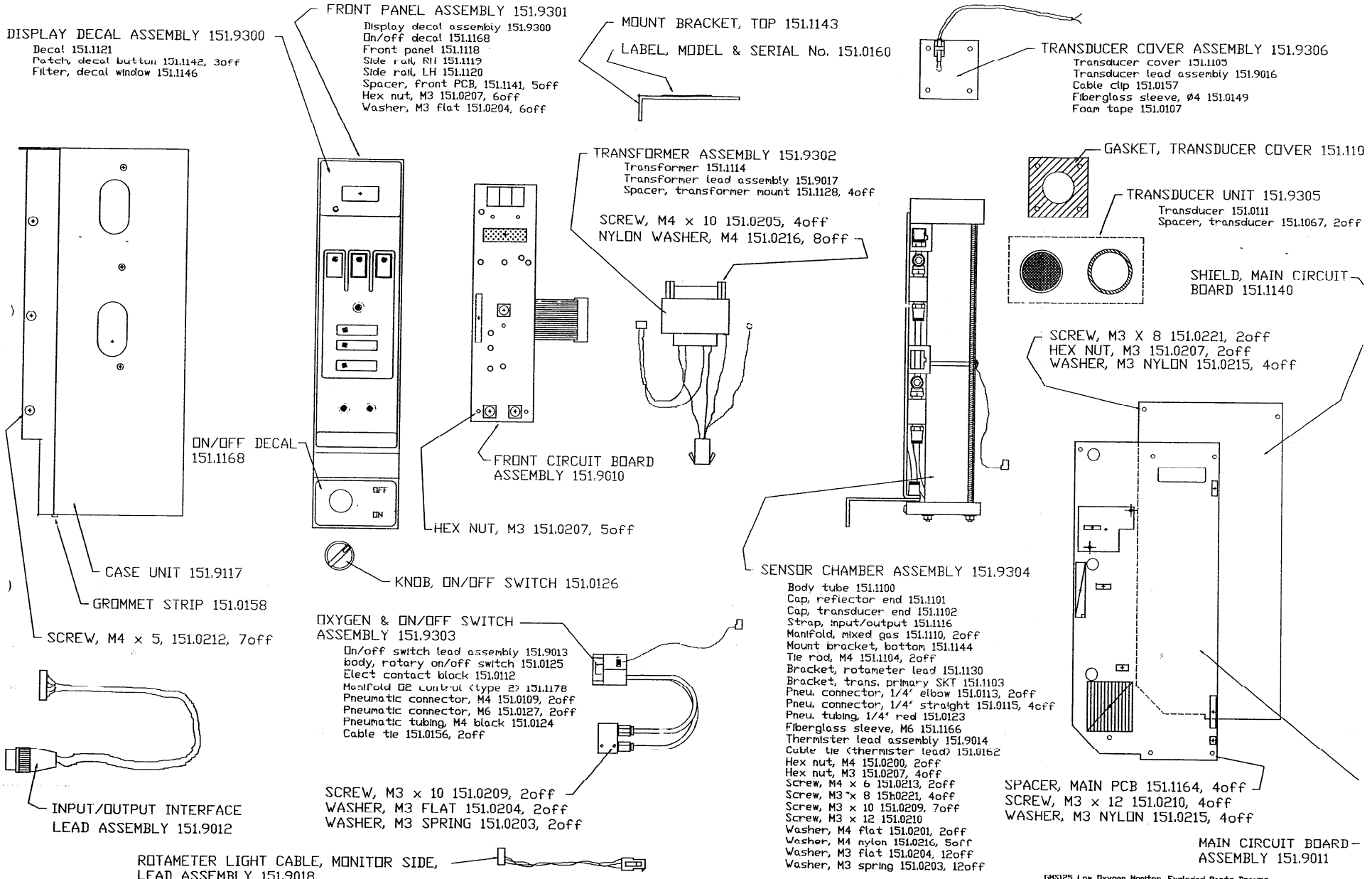
A pulse at P270 starts two monostables. The 70mS pulse from U9a starts the measurement sequence and ensures that the measurement electronics continues to operate until the process is complete. The 1.6mS output at the Q output of U9b blanks the receive circuit from responding until the ringing of the ultrasonic transducer is finished. At the same time as the ultrasonic signal is transmitted along the sample tube a high output appears at connector pin 6 to turn on Q15 and thus set the U10 flip-flop. Via U10c, the 3.333 MHz signal from TO is fed to the counter U11. When the echo is received pin 7 goes high and resets the flip-flop, stopping the count which can now be read to the micro.

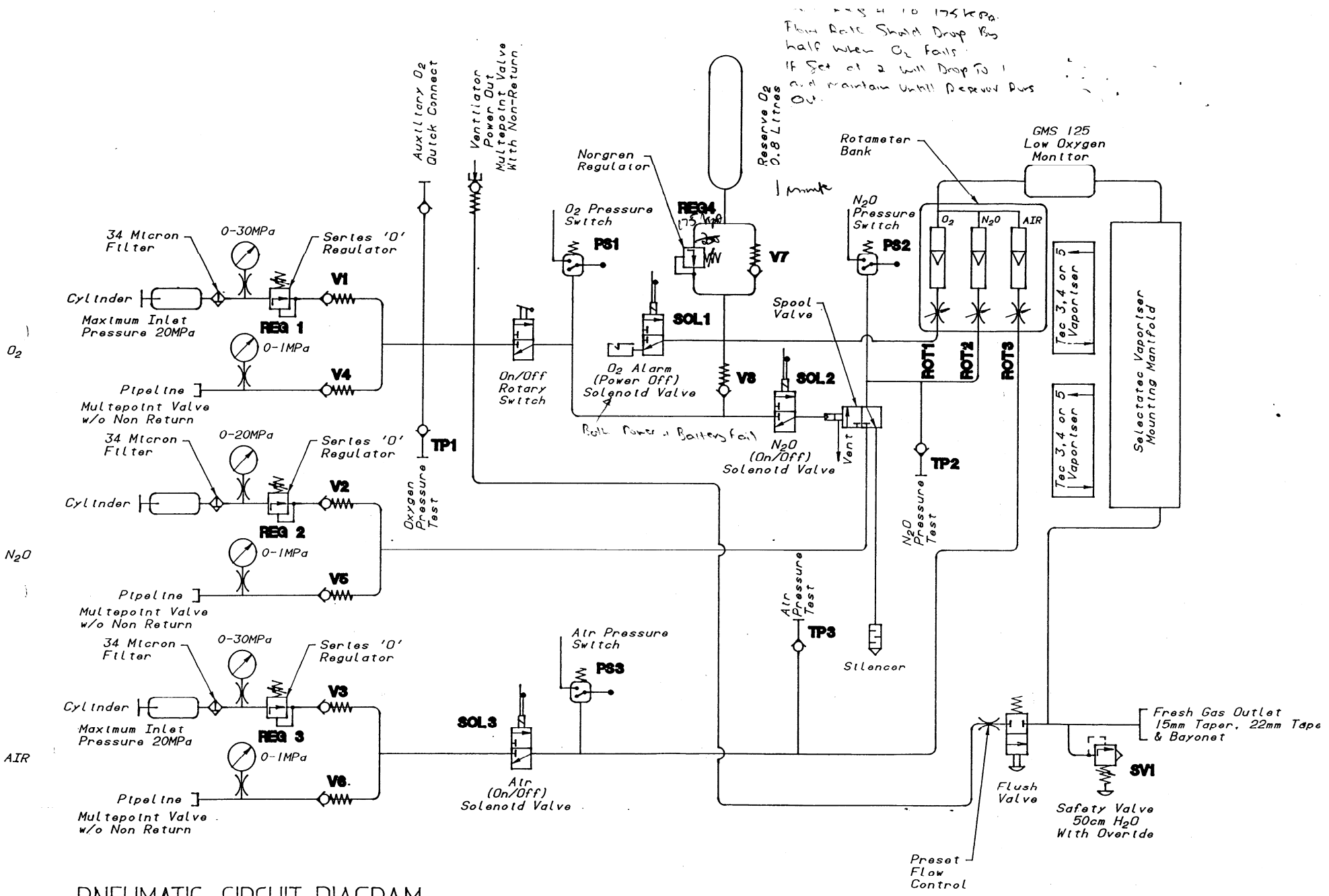
Because the magnitude of the echo signal decreases with increase in nitrous oxide content it is necessary to change the gain of the receive circuit. This is controlled via ports P271 and P263; both are high for the minimum gain which is required for all concentrations in Air and down to 85% Oxygen in Nitrous Oxide. For 85% down to 55% a medium gain is required and P263 is low; below 55% both ports are low to give the highest circuit gain. There is a hysteresis of +/-2% on the gain switching points so that, for example, P263 will go low at 83% on the way down and high at 87% on the way up.

Temperature Compensation: The velocity of sound in a gas is temperature dependent and it is therefore necessary to measure the temperature and correct for its effect. The A-D Converter U25 is fed by U24, a low offset op-amp which conditions the signal from the thermistor RT1 which is bonded to the sample tube. To set up the circuit, measure the resistance between pins 3 and 4 of U24 and adjust R64 so that the result is 8470 ohms. Similarly, adjust R68 so that the resistance between pins 1 and 2 is 7410 ohms.

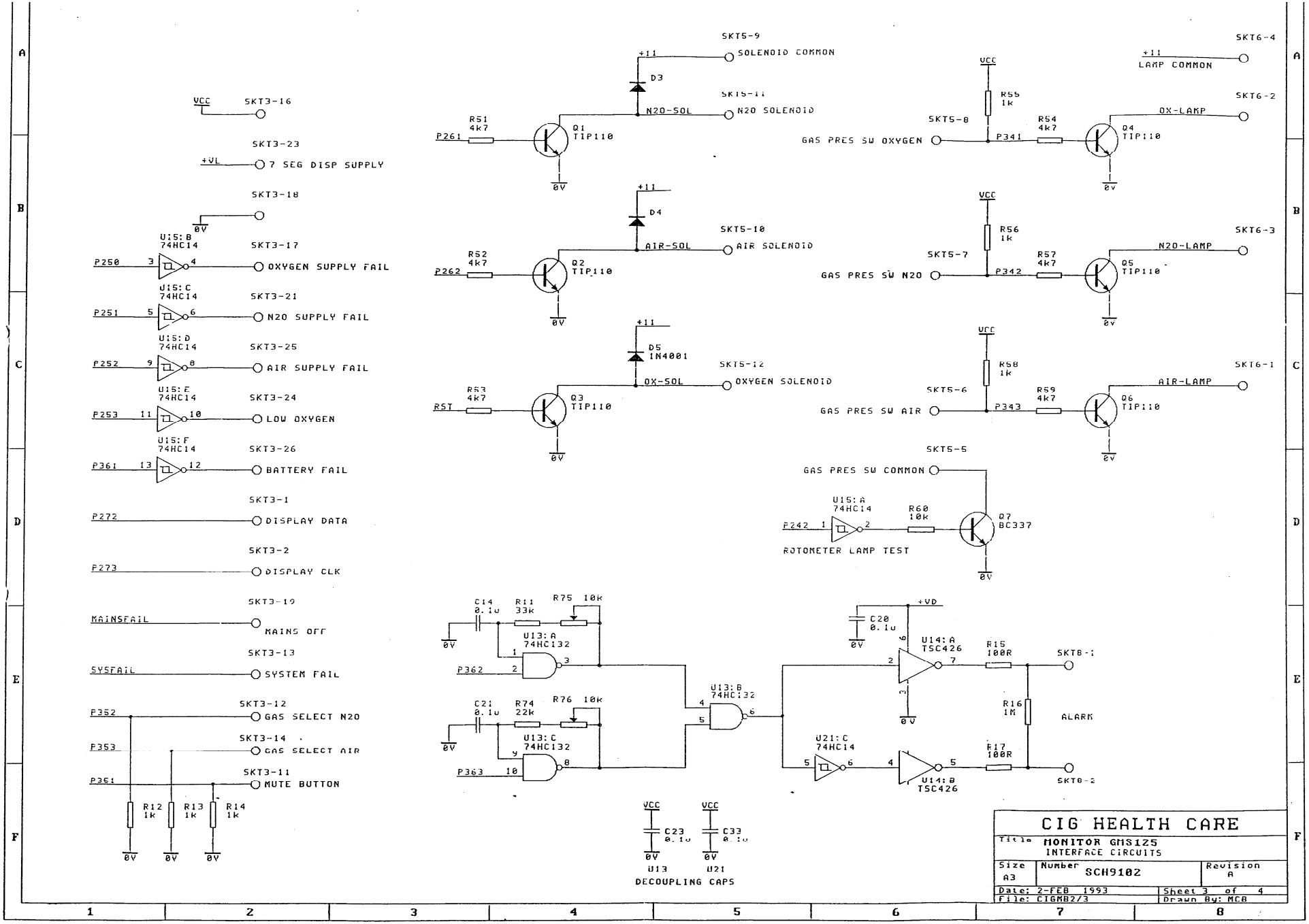
E GMS125 Alarm Chart

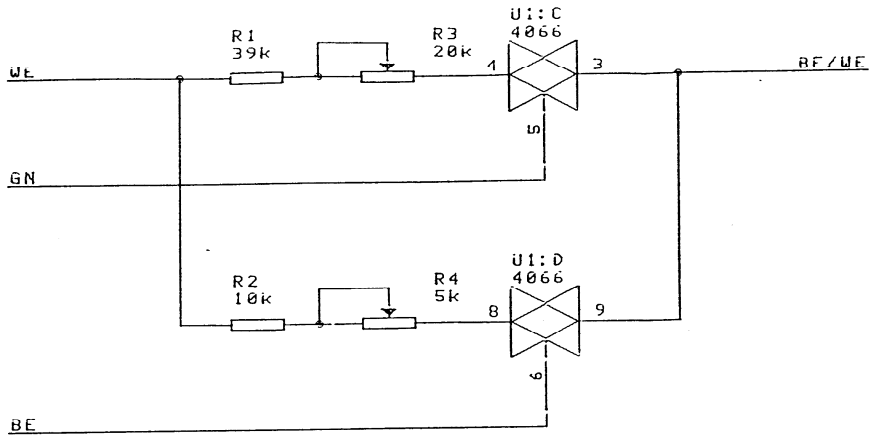
Alarm Condition	Visible Indication	Audible Tones	Mute Time	Other Actions
Software Alarms				
No Air when Air selected	AIR FAIL	High/Low	30 sec.	——
No N_2O when N_2O selected	N_2O FAIL	High/Low	30 sec.	——
Oxygen Supply Failure	O_2 FAIL	High/Low/High	15 sec.	N_2O shut off
% reading outside expected range	SYSTEM ERROR Blank Display	High/Low	30 sec. (EF3)	——
Air ON when not selected	SYSTEM ERROR	High/Low	30 sec. (EF2)	——
N_2O ON when not selected	SYSTEM ERROR	High/Low	30 sec. (EF2)	——
Battery volts less than 11.8 volts	LOW BATTERY	High/Low	Continuous	
% less than 24 in N_2O	LOW OXYGEN	High/Low/High	15 sec.	——
% less than 18 for 5 seconds	As above	As above	As above	N_2O shut off
% over 19 for 18 shut off				N_2O restored
Hardware Alarms				
Microcomputer failure	Random	Continuous Tone	No Mute	——
Failure of both mains and battery	No lights	Continuous Whistle Powered by Oxygen	No Mute	——
Mains off	MAINS OFF Light Blinks	Brief tone	No Mute	——

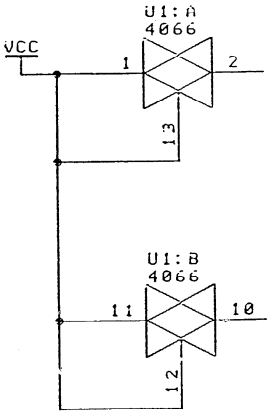

DISPLAY DECAL ASSEMBLY 151.9300
Decal 151.1121
Patch, decal button 151.1142, 3off
Filter, decal window 151.1146
FRONT PANEL ASSEMBLY 151.9301
Display decal assembly 151.9300
On/off decal 151.1168
Front panel 151.1118
Side rail, RH 151.1119
Side rail, LH 151.1120
Spacer, front PCB, 151.1141, 5off
Hex nut, M3 151.0207, 6off
Washer, M3 flat 151.0204, 6off
MOUNT BRACKET, TOP 151.1143
LABEL, MODEL & SERIAL No. 151.0160
TRANSDUCER COVER ASSEMBLY 151.9306
Transducer cover 151.1105
Transducer lead assembly 151.9016
Cable clip 151.0157
Fiberglass sleeve, Ø4 151.0149
Foam tape 151.0107
GASKET, TRANSDUCER COVER 151.110
TRANSDUCER UNIT 151.9305
Transducer 151.0111
Spacer, transducer 151.1067, 2off
SHIELD, MAIN CIRCUIT BOARD 151.1140
TRANSFORMER ASSEMBLY 151.9302
Transformer 151.1114
Transformer lead assembly 151.9017
Spacer, transformer mount 151.1128, 4off
SCREW, M4 x 10 151.0205, 4off
NYLON WASHER, M4 151.0216, 8off
ON/OFF DECAL 151.1168
FRONT CIRCUIT BOARD ASSEMBLY 151.9010
HEX NUT, M3 151.0207, 5off
KNOB, ON/OFF SWITCH 151.0126
CASE UNIT 151.9117
GROMMET STRIP 151.0158
SCREW, M4 x 5, 151.0212, 7off
SCREW, M3 X 8 151.0221, 2off
HEX NUT, M3 151.0207, 2off
WASHER, M3 NYLON 151.0215, 4off
SENSOR CHAMBER ASSEMBLY 151.9304
Body tube 151.1100
Cap, reflector end 151.1101
Cap, transducer end 151.1102
Strap, input/output 151.1116
Manifold, mixed gas 151.1110, 2off
Mount bracket, bottom 151.1144
Tie rod, M4 151.1104, 2off
Bracket, rotameter lead 151.1130
Bracket, trans. primary SKT 151.1103
Pneu. connector, 1/4" elbow 151.0113, 2off
Pneu. connector, 1/4" straight 151.0115, 4off
Pneu. tubing, 1/4" red 151.0123
Fiberglass sleeve, M6 151.1166
Thermister lead assembly 151.9014
Cable tie (thermister lead) 151.0162
Hex nut, M4 151.0200, 2off
Hex nut, M3 151.0207, 4off
Screw, M4 x 6 151.0213, 2off
Screw, M3 x 8 151.0221, 4off
Screw, M3 x 10 151.0209, 7off
Screw, M3 x 12 151.0210
Washer, M4 flat 151.0201, 2off
Washer, M4 nylon 151.0216, 5off
Washer, M3 flat 151.0204, 12off
Washer, M3 spring 151.0203, 12off
OXYGEN & ON/OFF SWITCH ASSEMBLY 151.9303
On/off switch lead assembly 151.9013
Body, rotary on/off switch 151.0125
Elect contact block 151.0112
Manifold O2 control (type 2) 151.1178
Pneumatic connector, M4 151.0109, 2off
Pneumatic connector, M6 151.0127, 2off
Pneumatic tubing, M4 black 151.0124
Cable tie 151.0156, 2off
SCREW, M3 x 10 151.0209, 2off
WASHER, M3 FLAT 151.0204, 2off
WASHER, M3 SPRING 151.0203, 2off
INPUT/OUTPUT INTERFACE LEAD ASSEMBLY 151.9012
ROTAMETER LIGHT CABLE, MONITOR SIDE, LEAD ASSEMBLY 151.9018
SPACER, MAIN PCB 151.1164, 4off
SCREW, M3 x 12 151.0210, 4off
WASHER, M3 NYLON 151.0215, 4off
MAIN CIRCUIT BOARD ASSEMBLY 151.9011
OFF
ON

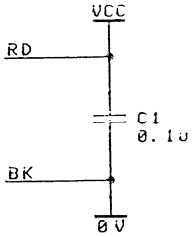


PNEUMATIC CIRCUIT DIAGRAM


SKT3-16
VCC
SKT3-23
+VL
7 SEG DISP SUPPLY
SKT3-18
0V
U15:B 74HC14
SKT3-17
P250
OXYGEN SUPPLY FAIL
U15:C 74HC14
SKT3-21
P251
N2O SUPPLY FAIL
U15:D 74HC14
SKT3-25
P252
AIR SUPPLY FAIL
U15:E 74HC14
SKT3-24
P253
LOW OXYGEN
U15:F 74HC14
SKT3-26
P361
BATTERY FAIL
SKT3-1
P272
DISPLAY DATA
SKT3-2
P273
DISPLAY CLK
SKT3-19
MAINSFAIL
MAINS OFF
SKT3-13
SYSFAIL
SYSTEM FAIL
SKT3-12
P352
GAS SELECT N2O
SKT3-14
P353
GAS SELECT AIR
SKT3-11
P361
MUTE BUTTON
R12 1k
R13 1k
R14 1k
SKT5-9
+11
SOLENOID COMMON
D3
SKT5-11
N2O-SOL
N2O SOLENOID
R51 4k7
P261
Q1 TIP110
D4
SKT5-10
AIR-SOL
AIR SOLENOID
R52 4k7
P262
Q2 TIP110
D5 1N4001
SKT5-12
OX-SOL
OXYGEN SOLENOID
R53 4k7
RST
Q3 TIP110
SKT6-4
+11
LAMP COMMON
SKT6-2
OX-LAMP
R55 1k
SKT5-8
GAS PRES SW OXYGEN
P341
R54 4k7
Q4 TIP110
SKT6-3
N2O-LAMP
R56 1k
SKT5-7
GAS PRES SW N2O
P342
R57 4k7
Q5 TIP110
SKT6-1
AIR-LAMP
R58 1k
SKT5-6
GAS PRES SW AIR
P343
R59 4k7
Q6 TIP110
SKT5-5
GAS PRES SW COMMON
U15:A 74HC14
P242
R60 10k
Q7 BC337
ROTOMETER LAMP TEST
C14 0.1u
R11 33k
R75 10k
U13:A 74HC132
P362
C21 0.1u
R74 22k
R76 10k
U13:C 74HC132
P363
U13:B 74HC132
+VD
C20 0.1u
U14:A TSC426
R15 100R
SKT8-1
R16 1M
ALARM
U21:C 74HC14
R17 100R
U14:B TSC426
SKT8-2
C23 0.1u
C33 0.1u
U13
U21
DECOUPLING CAPS
CIG HEALTH CARE
Title MONITOR GMS125
INTERFACE CIRCUITS
Size A3
Number SCH9102
Revision A
Date: 2-FEB 1993
Sheet 3 of 4
File: CIGMB2/3
Drawn By: MCB



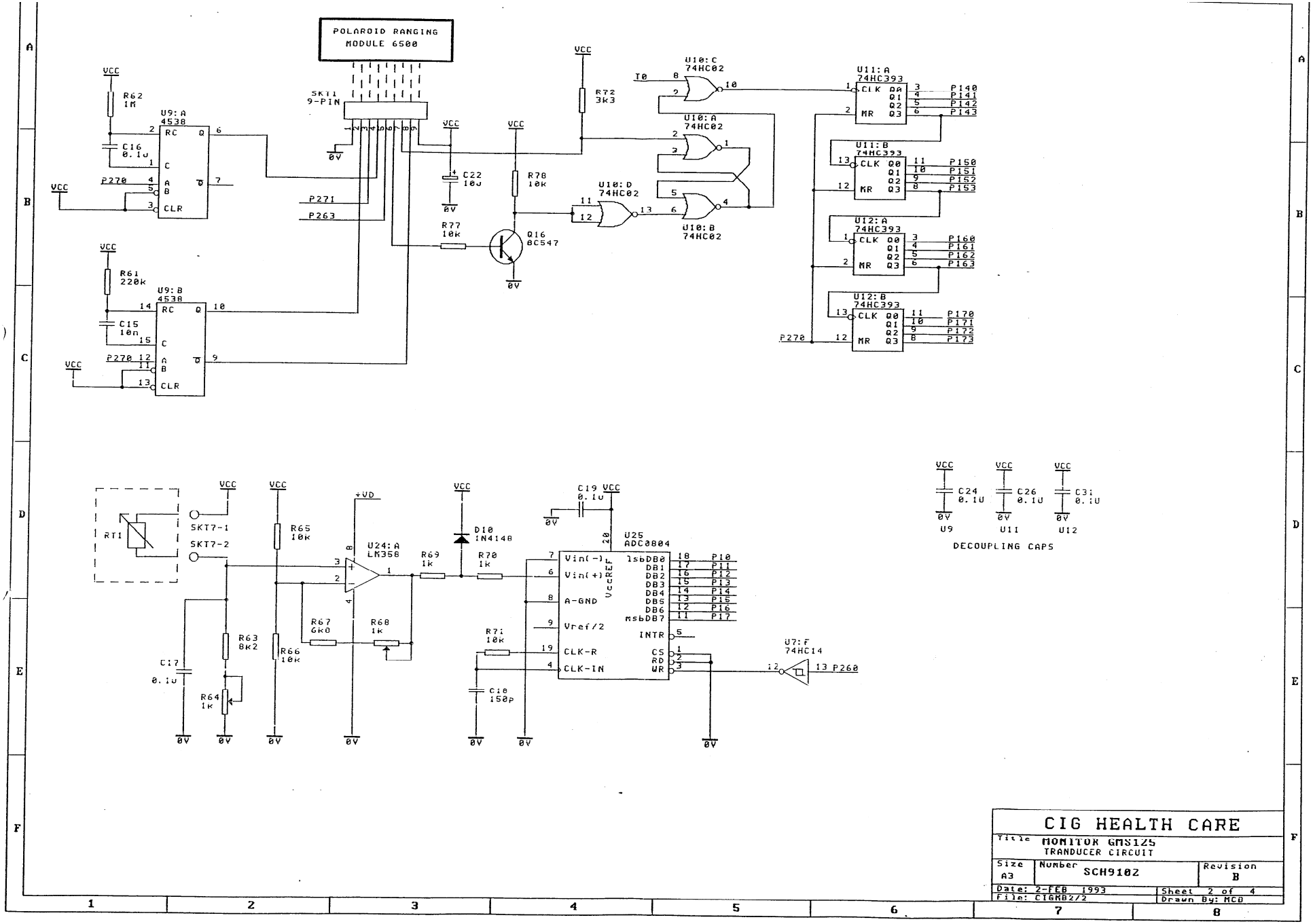




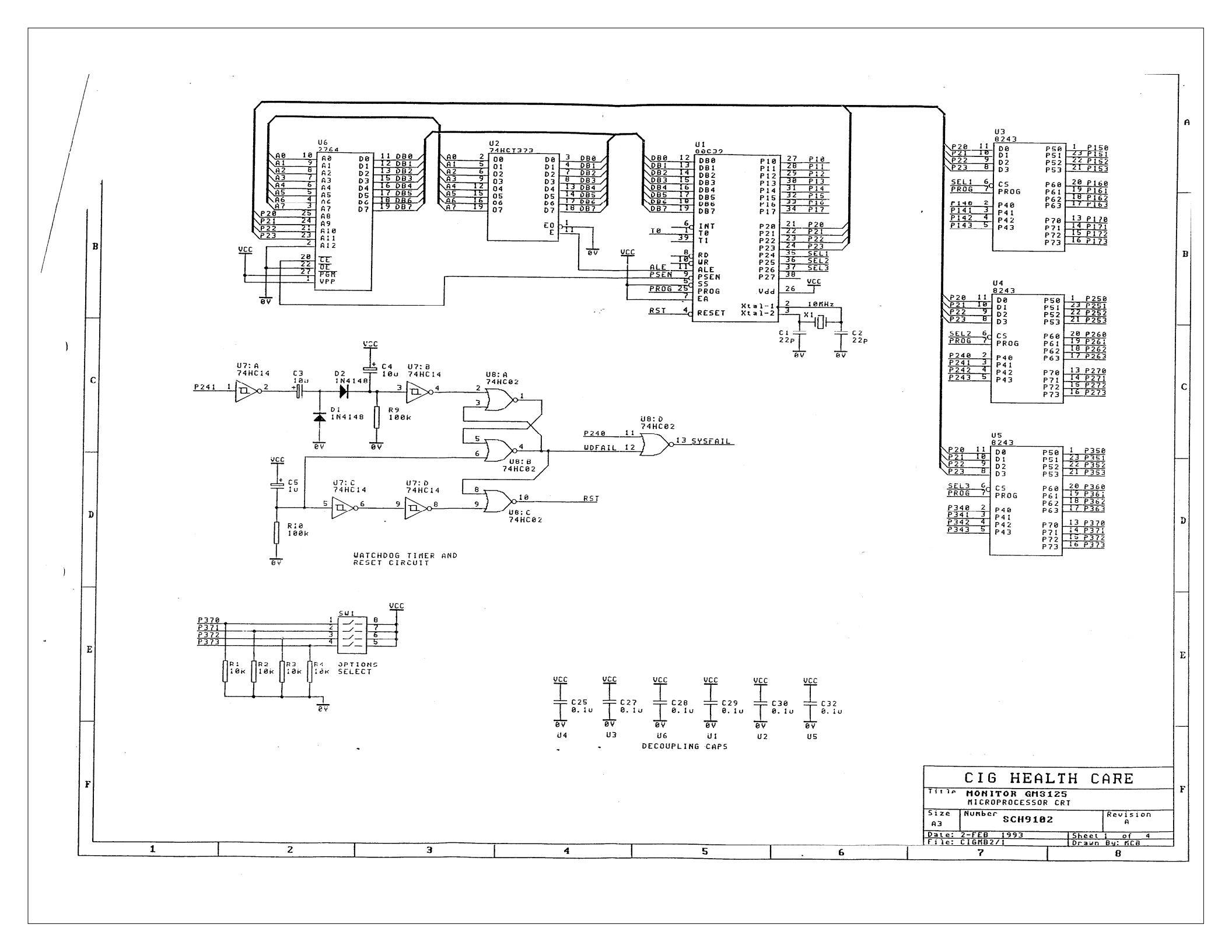
WIRE TABLE	
BE	Blue
BK	Black
WE	White
GN	Green
RD	Red

CIG HEALTH CARE

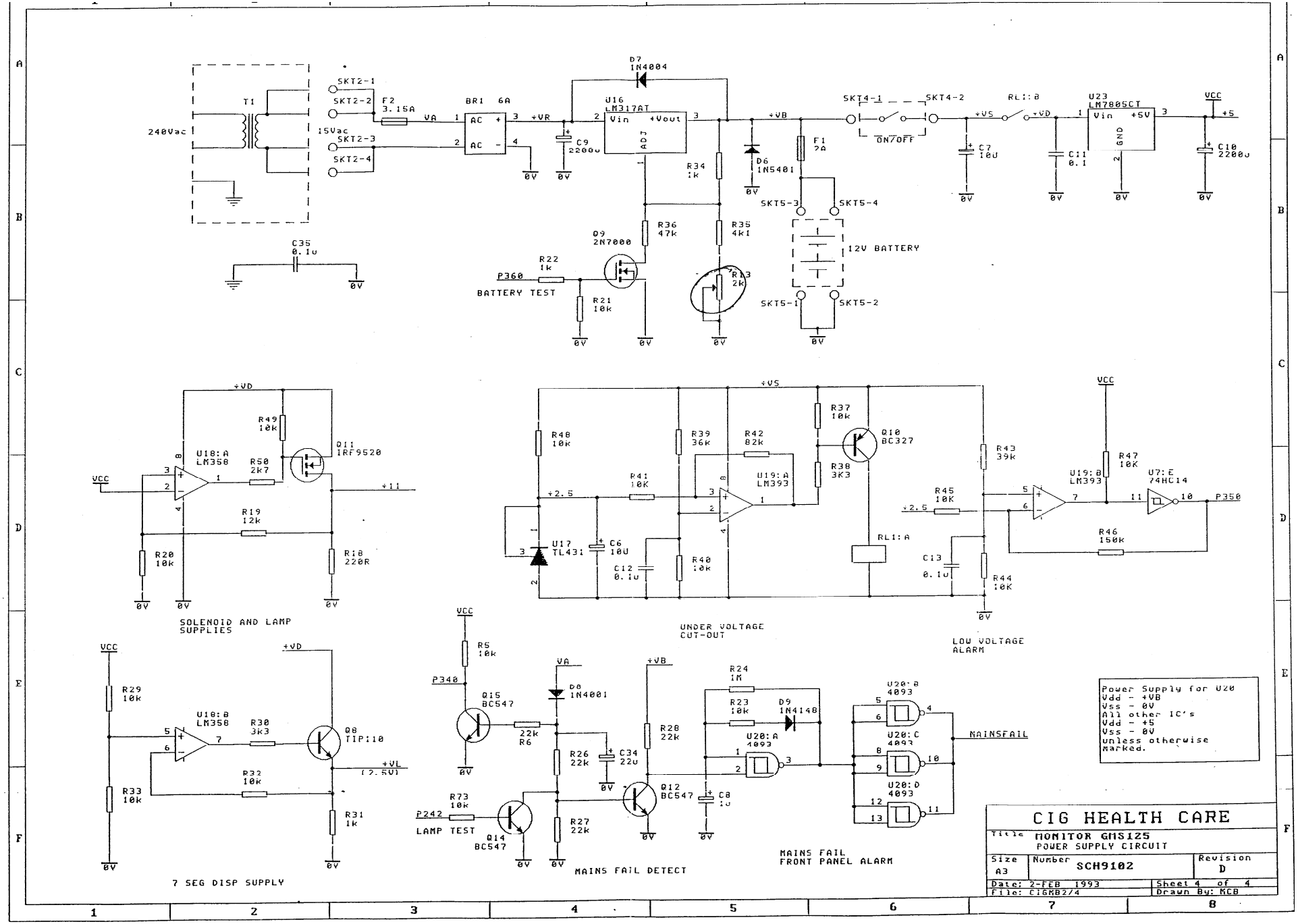
Title: MONITOR GMS125 POLAROID PIGGY-BACK PCB		
Size: A4	Number: SCH9103	Revision: A
Date: 8-FEB 1993		Sheet 1 of 2
File: CIGPOL/1		Drawn By: MCB

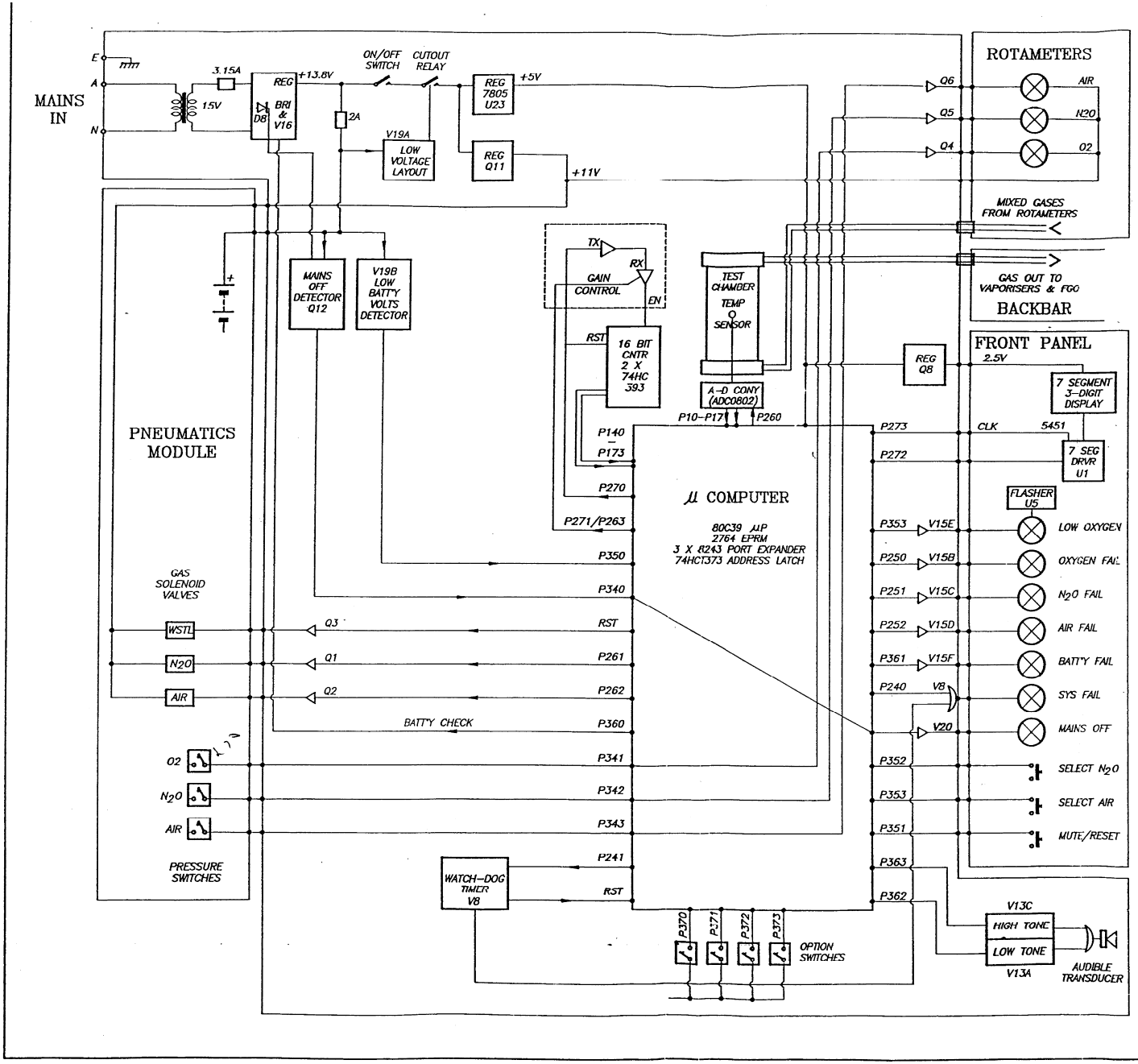


Title	CIG HEALTH CARE
	MONITOR GMS125 TRANDUCER CIRCUIT
Size	A3
Number	SCH9102
Revision	B
Date:	2-FEB 1993
File:	CIGMB2/2
Sheet	2 of 4
Drawn By:	MCB



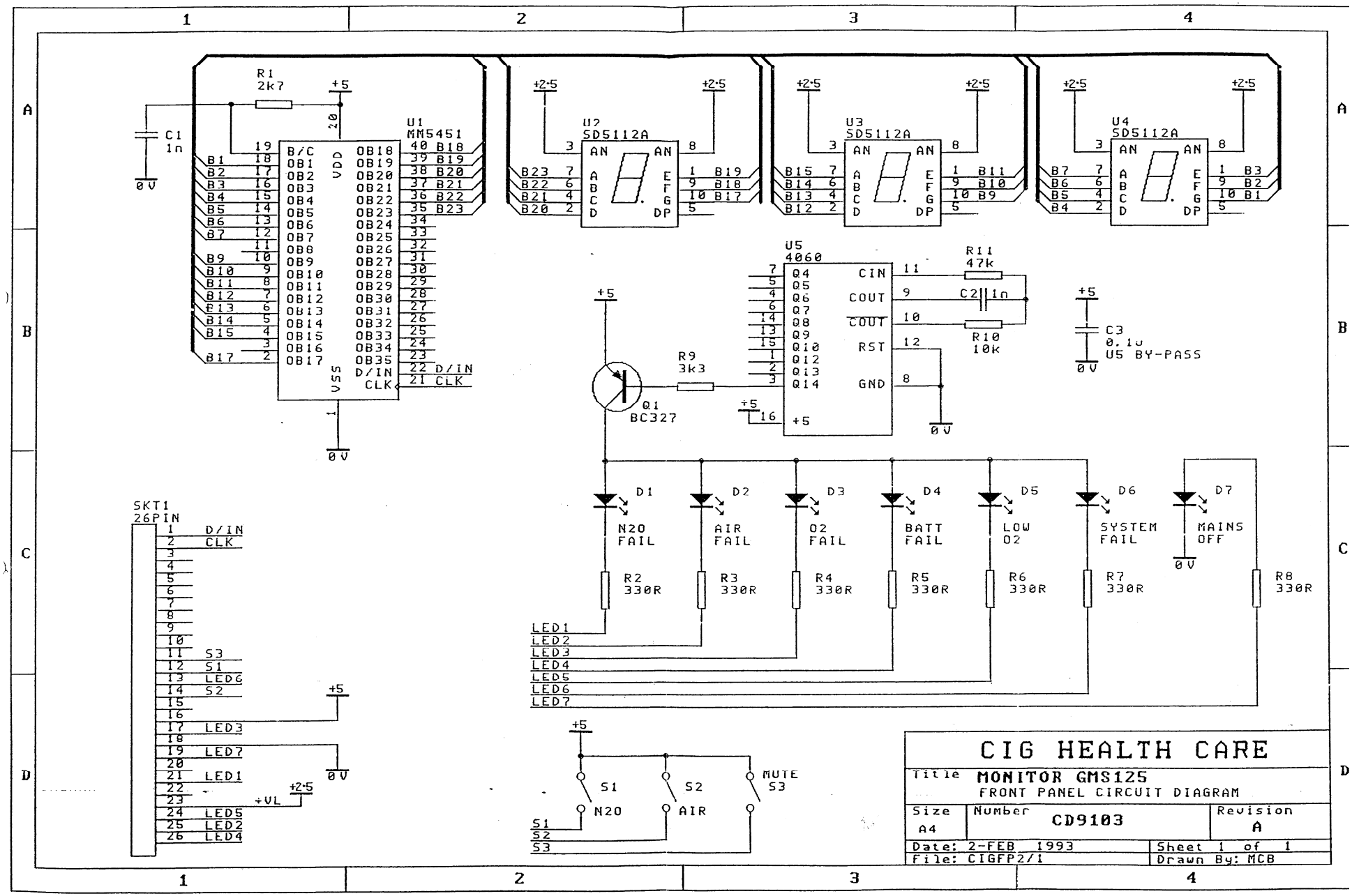
CIG HEALTH CARE	
Title	MONITOR GM3125 MICROPROCESSOR CRT
Size A3	Number SCH9102
Revision A	
Date: 2-FEB 1993	Sheet 1 of 4
File: CIGMB2/1	Drawn By: MCB


T1
240Vac
15Vac
SKT2-1
SKT2-2
SKT2-3
SKT2-4
F2
3.15A
VA
BR1 6A
AC
AC
+VR
D7
1N4004
U16
LM317AT
Vin
+Vout
ADJ
C9
2200u
0V
+VB
D6
1N5401
F1
2A
SKT4-1
SKT4-2
ON/OFF
+VS
RL1:B
U23
LM7805CT
Vin
+5V
GND
+VD
C7
10U
C11
0.1
C10
2200u
VCC
+5
C35
0.1u
R34
1k
R36
47k
R35
4k1
D9
2N7000
R22
1k
P360
BATTERY TEST
R21
10k
R13
2k
SKT5-3
SKT5-4
SKT5-1
SKT5-2
12V BATTERY
U18:A
LM358
R49
10k
Q11
IRF9520
R50
2k7
+11
R19
12k
R20
10k
R18
220R
SOLENOID AND LAMP
SUPPLIES
R48
10k
R39
36k
R42
82k
R37
10k
Q10
BC327
R38
3K3
R41
10K
+2.5
U19:A
LM393
U17
TL431
C6
10U
C12
0.1u
R40
10k
RL1:A
R43
39k
R45
10K
C13
0.1u
R44
10K
U19:B
LM393
U7:E
74HC14
R47
10K
P350
R46
150k
UNDER VOLTAGE
CUT-OUT
LOW VOLTAGE
ALARM
U18:B
LM358
R29
10k
R30
3k3
Q8
TIP:10
+VL
(2.5V)
R32
10k
R33
10k
R31
1k
7 SEG DISP SUPPLY
R5
10k
P340
Q15
BC547
22k
R6
D8
1N4001
VA
+VB
R28
22k
R26
22k
C34
22u
R73
10k
P242
LAMP TEST
Q14
BC547
R27
22k
Q12
BC547
C8
1u
R24
1M
R23
10k
D9
1N4148
U20:A
4093
U20:B
4093
U20:C
4093
U20:D
4093
MAINSFAIL
MAINS FAIL DETECT
MAINS FAIL
FRONT PANEL ALARM
Power Supply for U20
Vdd - +VB
Vss - 0V
All other IC's
Vdd - +5
Vss - 0V
unless otherwise
marked.
CIG HEALTH CARE
Title MONITOR GMS125
POWER SUPPLY CIRCUIT
Size A3
Number SCH9102
Revision D
Date: 2-FEB 1993
Sheet 4 of 4
File: CIGMB2/4
Drawn By: MCB



GMS125
LOW OXYGEN MONITOR
BLOCK DIAGRAM

CIG
Health
Care


R1
2k7
+5
C1
1n
0V
U1
MM5451
U2
SD5112A
U3
SD5112A
U4
SD5112A
+2·5
U5
4060
R11
47k
C2
1n
R10
10k
C3
0.1u
U5 BY-PASS
R9
3k3
Q1
BC327
D1
N20
FAIL
D2
AIR
FAIL
D3
O2
FAIL
D4
BATT
FAIL
D5
LOW
O2
D6
SYSTEM
FAIL
D7
MAINS
OFF
R2
330R
R3
330R
R4
330R
R5
330R
R6
330R
R7
330R
R8
330R
LED1
LED2
LED3
LED4
LED5
LED6
LED7
SKT1
26PIN
D/IN
CLK
S3
S1
LED6
S2
LED3
LED7
LED1
+VL
LED5
LED2
LED4
MUTE
S1
S2
S3
N20
AIR
CIG HEALTH CARE
Title
MONITOR GMS125
FRONT PANEL CIRCUIT DIAGRAM
Size
A4
Number
CD9103
Revision
A
Date: 2-FEB 1993
Sheet 1 of 1
File: CIGFP2/1
Drawn By: MCB

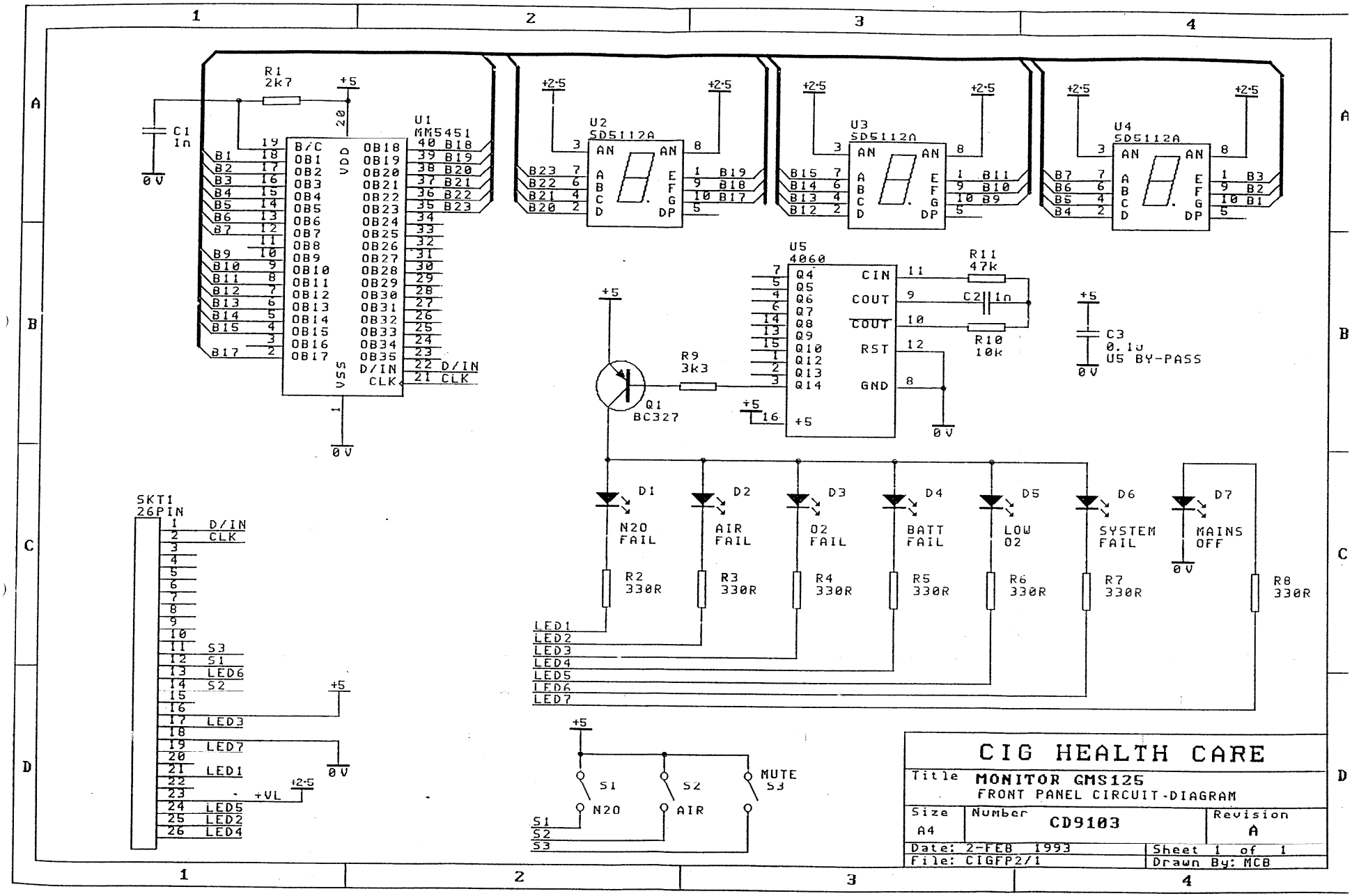
6-MAR-92	SCH9102/2	REV B	CHANGE Q15 TO Q16.
	SCH9102/4	REV B	CHANGE R36 FROM 39k TO 47k)
			CHANGE R43 FROM 36k TO 39k) TO WIDEN LOW/UNDER VOLTS TOLERANCE.
			CHANGE R46 FROM 390k TO 270k)
31-MAY-92	SCH9102/4	REV C	CHANGE R46 FROM 270k TO 150k) TO LOWER 'BATT FAIL' VOLTS LEVEL
			CHANGE R36 FROM 47k TO 56k)
			CHANGE U16 FROM LM317T TO LM317AT TO REDUCE VOLTS TOLERANCE
5-JUN-92	SCH9102/4	REV D	CHANGE R36 FROM 56k TO 47k) TO LOWER 'CUT-OUT' VOLTAGE LEVEL
			CHANGE R39 FROM 39k TO 36k)
7-DEC-92	SCH9103/2	REV B	LINK WHERE C2 WAS REMOVED
			CUT U1 PIN 6 FROM VR1
			ADD 22k RESISTOR BETWEEN VR1 AND +5V RAIL (LEG OF L1)

CIG HEALTH CARE

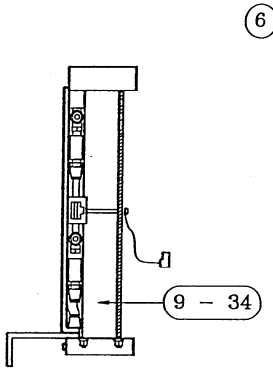
Title: MONITOR GMS125
CHANGE LIST - CIRCUIT DIAGRAMS

Size	Number	Revision
A4	SCH9102	E

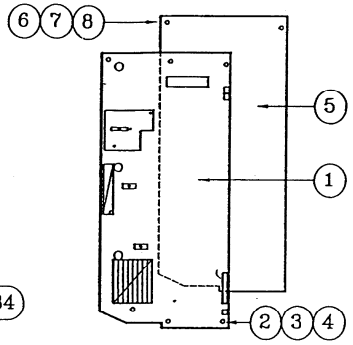
Date: 7-FEB 1993	Sheet 5 of 5
File: CIGMN2/5	Drawn By: MCB


R1
2k7
+5
C1
In
0V
U1
MM5451
B/C
VDD
VSS
OB1
OB2
OB3
OB4
OB5
OB6
OB7
OB8
OB9
OB10
OB11
OB12
OB13
OB14
OB15
OB16
OB17
OB18
OB19
OB20
OB21
OB22
OB23
OB24
OB25
OB26
OB27
OB28
OB29
OB30
OB31
OB32
OB33
OB34
OB35
D/IN
CLK
B1
B2
B3
B4
B5
B6
B7
B9
B10
B11
B12
B13
B14
B15
B17
B18
B19
B20
B21
B22
B23
U2
SD5112A
U3
SD5112A
U4
SD5112A
AN
A
B
C
D
E
F
G
DP
+2·5
U5
4060
CIN
COUT
RST
GND
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q12
Q13
Q14
R11
47k
C2
1n
R10
10k
C3
0.1u
U5 BY-PASS
R9
3k3
Q1
BC327
D1
N20
FAIL
D2
AIR
FAIL
D3
O2
FAIL
D4
BATT
FAIL
D5
LOW
O2
D6
SYSTEM
FAIL
D7
MAINS
OFF
R2
330R
R3
330R
R4
330R
R5
330R
R6
330R
R7
330R
R8
330R
LED1
LED2
LED3
LED4
LED5
LED6
LED7
SKT1
26PIN
D/IN
CLK
S3
S1
LED6
S2
LED3
LED7
LED1
+VL
LED5
LED2
LED4
MUTE
S3
S1
S2
N20
AIR
CIG HEALTH CARE
Title
MONITOR GMS125
FRONT PANEL CIRCUIT-DIAGRAM
Size
A4
Number
CD9103
Revision
A
Date: 2-FEB 1993
Sheet 1 of 1
File: CIGFP2/1
Drawn By: MCB

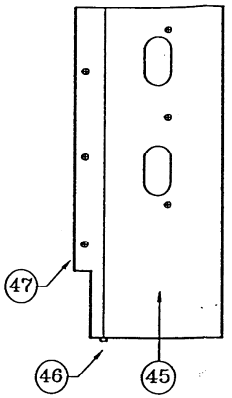
ITEM	PART No	DESCRIPTION	QTY
1	151 9011	MAIN CIRCUIT BOARD ASSEMBLY	–
2	151 1148	SPACER/MAIN PCB	4
3	151 0210	SCREW M3 X 12	4
4	151 0215	WASHER M3 NYLON	4
5	151 1140	SHIELD/MAIN CIRCUIT	–
6	151 0221	SCREW M3 X 8	2
7	151 0207	HEX NUT M3	2
8	151 0215	WASHER M3 NYLON	4
9	151 9304	SENSOR CHAMBER ASSEMBLY	–
10	151 1100	BODY TUBE	–
11	151 1101	CAP/REFLECTOR END	–
12	151 1102	CAP/TRANSDUCER END	–
13	151 1116	STRAP INPUT/OUTPUT	–
14	151 1110	MANIFOLD/MIXED GAS	2
15	151 1144	MOUNTING BRACKET/BOTTOM	–
16	151 1104	TIE ROD M4	2
17	151 1130	BRACKET/ROTAMETER LEAD	–
18	151 1103	BRACKET/TRANS PRIMARY SKT	–
19	151 0113	PNEU/CONNECTOR 1/4" ELBOW	2
20	151 0115	PNEU/CONNECTOR 1/4" STRAIGHT	4
21	151 0123	PNEU TUBING 1/4" RED	–
22	151 1166	FIBERGLASS SLEEVE M6	–
23	151 9014	THERMISTER LEAD ASSEMBLY	–
24	151 0162	CABLE TIE (THERMISTER LEAD)	–
25	151 0200	NAX NUT M4	2
26	151 0207	HEX NUT M3	4
27	151 0213	SCREW M4 X 6	2
28	151 0221	SCREW M3 X 8	4
29	151 0209	SCREW M3 X 10	7
30	151 0210	SCREW M3 X 12	–
31	151 0201	WASHER M4/FLAT	2
32	151 0216	WASHER M4/NYLON	5
33	151 0204	WASHER M3/FLAT	12
34	151 0203	WASHER M3/SPRING	12
35	151 9305	TRANSDUCER UNIT	–
36	151 0111	TRANSDUCER	–
37	151 1067	SPACER/TRANSDUCER	2
38	151 1106	GASKET/TRANSDUCER COVER	–
39	151 9306	TRANSDUCER COVER ASSEMBLY	–
40	151 1105	TRANSDUCER COVER	–
41	151 9016	TRANSDUCER LEAD ASSEMBLY	–
42	151 0157	CABLE CLIP	–
43	151 0149	FIBERGLASS SLEEVE 4 DIA	–
44	151 0107	FOAM TAPE	–
45	151 9117	CASE UNIT	–
46	151 0158	GROMMET STRIP	–
47	151 0212	SCREW M4 X 5	7
48	151 9300	DISPLAY DECAL ASSEMBLY	–
49	151 1121	DECAL	–
50	151 1142	PATCH DECAL BUTTON	3
51	151 1146	FILTER DECAL WINDOW	–
52	151 9301	FRONT PANEL ASSEMBLY	–
53	151 9300	DISPLAY DECAL ASSEMBLY	–
54	151 1168	ON/OFF DECAL	–
55	151 1118	FRONT PANEL	–
56	151 1119	SIDE RAIL RH	–
57	151 1120	SIDE RAIL LH	–
58	151 1141	SPACER/FRONT PCB	5
59	151 0207	HEX NUT M3	6
60	151 0201	WASHER M3 FLAT	6
61	151 1168	ON/OFF DECAL	–
62	151 0126	KNOB ON/OFF SWITCH	–
63	151 9010	FRONT CIRCUIT BOARD	–
64	151 0207	HEX NUT M3	5
65	151 0215	WASHER M3 NYLON	5
66	151 9302	TRANSFORMER ASSEMBLY	–
67	151 1114	TRANSFORMER	–
68	151 9017	TRANSFORMER LEAD ASSEMBLY	–
69	151 1128	SPACER TRANSFORMER_MOUNT	4
70	151 0205	SCREW M4 X 10	4
71	151 0216	WASHER M4 NYLON	6
72	151 9303	OXYGEN & ON/OFF SWITCH ASS'Y	–
73	151 9013	ON/OFF SWITCH LEAD ASSEMBLY	–
74	151 0125	BODY ROTARY ON/OFF SWITCH	–
75	151 0112	ELECT CONTACT BLOCK	–
76	151 1145	MANIFOLD OXYGEN CONTROL	–
77	151 0129	PNEUMATIC SWITCH VALVE	–
78	151 0109	PNEUMATIC CONNECTOR M4	3
79	151 0127	PNEUMATIC CONNECTOR M6	2
80	151 0124	PNEUMATIC TUBING M4 BLACK	–
81	151 0156	CABLE TIE	2
82	151 0209	SCREW M3 X 10	2
83	151 0204	WASHER M3 FLAT	2
84	151 0203	WASHER M3 SPRING	2
85	151 9012	INPUT/OUTPUT INTERFACE LEAD ASSEMBLY	–
86	151 9018	ROTAMETER LIGHT CABLE MONITOR SIDE LEAD ASSEMBLY	–
87	151 1143	MOUNT BRACKET TOP	–
88	151 0160	LABEL MODEL & SERIAL No	–



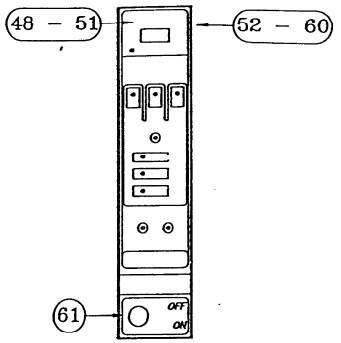
SENSOR CHAMBER ASSEMBLY



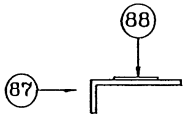
MAIN CIRCUIT BOARD ASSEMBLY



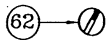
CASE UNIT



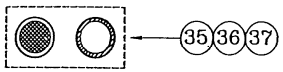
FRONT PANEL ASSEMBLY



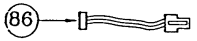
MOUNTING BRACKET



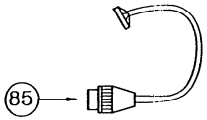
KNOB ON/OFF SWITCH



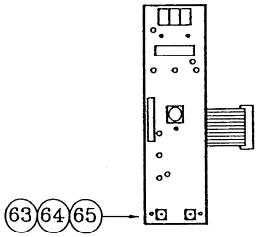
TRANSDUCER UNIT



ROTAMETER LIGHT CABLE MONITOR SIDE LEAD ASSEMBLY

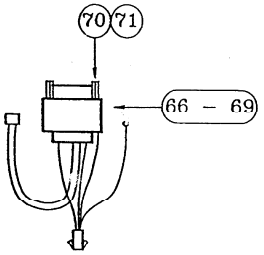


INPUT/OUTPUT INTERFACE LEAD ASSEMBLY

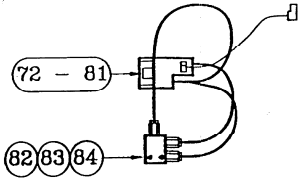


FRONT CIRCUIT BOARD

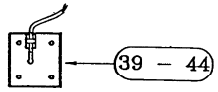
GASKET TRANSDUCER COVER



TRANSFORMER ASSEMBLY



OXYGEN ON/OFF SWITCH ASSEMBLY



TRANSDUCER COVER ASSEMBLY

GMS125
LOW OXYGEN MONITOR
EXPLODED PARTS DETAILS

CIG Health Care

6.1 Service Procedures

A General

1. Calibrate and perform Preventative Maintenance on the GEM™9100 Anaesthesia System in accordance with the schedule listed below.

2. Request that the system is cleaned and cleared of all non-related drugs, phials etc. and that all contaminated patient circuits are removed before the system is presented for service procedures.

3. Check and record the system Serial No. and determine which procedure, either a three month, six month calibration and test or an annual service, is required.

Warning: Before disconnecting any gas supply tube or electrical lead ensure that it incorporates an identification sleeve and, if necessary, fit an additional temporary identification to facilitate correct reconnection. Remove the temporary identification when the reconnection is completed. Failing to reconnect a supply tube or an electrical connection correctly can cause an incorrect gas delivery and possibly patient injury.

B Service Procedure

1. Close all gas cylinder outlets, disconnect all pipeline gas supply hoses at both inlet and outlet connections.

2. Release all residual gas from the system, disconnect all breathing tubes, accessory equipment and electrical supply plugs.

3. Remove Tec® Vaporisers, check exchange dates and inspect all vaporisers for mechanical damage.

4. Remove all cylinders, remove work surface.

Note: Whilst the ETU tester is called for in this manual, any other equivalent test equipment may be used.

6.2 Pipeline Gas Hose

Inspect for correct colour coding and sleeve indexing.

6.3 Frame and Castors

1. Inspect the top shelf, for condition and security of attachment.
2. Inspect the work surface support for condition and security of attachment.
3. Inspect all components within the work surface compartment for condition and security of attachment.
4. Inspect the absorber mounting post assembly for condition and for vertical and lateral adjustment.
5. Inspect the drawer unit for condition and security of attachment, ensuring that each drawer opens and closes freely.
6. Inspect the castor legs for condition and security of attachment, two screws on each leg, and inspect the plastic buffers for condition and security of attachment.
7. Lift the brake to the OFF condition and check that all four castors rotate and pivot freely. Depress the brake to the ON condition and check that neither of the two front castors can either rotate or pivot in any direction.
8. Inspect and tighten multerail and attachments.

6.4 Gas Supply System

Caution: Service only one gas supply system at a time, commencing with the right hand oxygen system viewed from the rear in order to minimise the possibility of components from two or more gas supply systems being interchanged.

1. Fully tighten and then fully unscrew the cylinder yoke wing screw to check for freedom of movement. Apply a smear of approved Vac Kote or Fomblin UT 18 lubricant to the screw threads if required and clean off any surplus lubricant.
2. Inspect the cylinder index pins for condition and security. If any pin is loose or damaged, fit a new system cylinder yoke.
3. Remove and discard the cylinder gasket (bodok seal) from the cylinder inlet fitting.

6.5 Gas Supply System - Testing and Calibration

Caution: Test and calibrate each gas supply system individually, commencing with the right hand oxygen gas supply system viewed from the rear in order to minimise the possibility of components from two or more gas supply systems being interchanged.

A Test Configuration

1. Connect the test configuration, illustrated on Fig. 6.1 to the gas supply system.
2. Test each gas supply system individually using the relevant test lead and adapter, illustrated on Fig 6.1.

Note: 1. Before commencing each pressure test, reset the Ohmeda Electronic Test Unit meter (or equivalent) to zero.
2. Bio-Tek analyser model no..... is recommended as an alternative to the ETU.

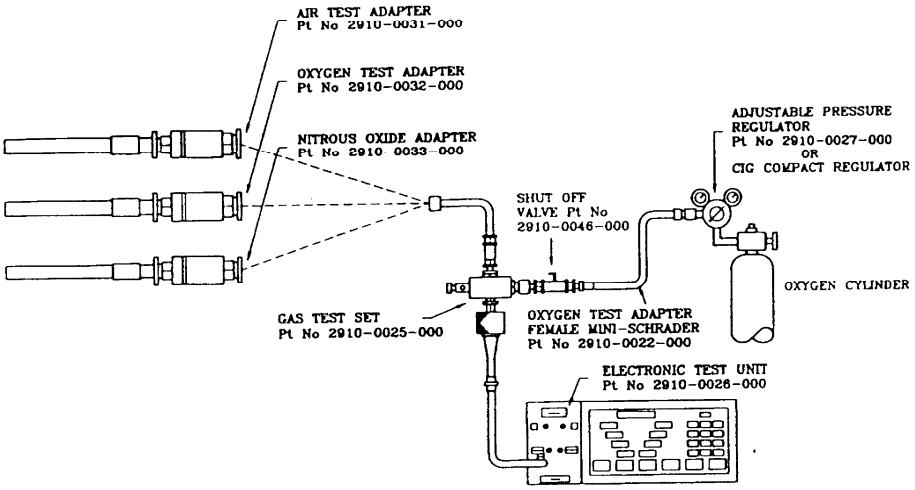


Fig 6.1 Testing Gas Supply Systems

B High Pressure Leak Test - Pipeline and Cylinder Non-return Valves and Gas Supply Block Pressure Relief Valve

1. Turn the APR handwheel slowly clockwise to increase the pressure until 350 kPa is indicated on the ETU display and allow the pressure to stabilise.
2. Turn the pressure control tap fully clockwise to shut off the cylinder supply and allow the pressure to stabilise.
3. Set a 1 minute leak test on the ETU and check that the pressure decrease is not more than 10kPa.
4. If a pressure decrease of more than 10kpa is indicated, leak test the pipeline and cylinder non-return valves as described in Fig 6.2.
5. If both non-return valves are leak-free, check all fittings and cylinder regulator separately for leak tightness by using snoop or equivalent and by process of elimination.
6. Turn the gas test set control valve counter-clockwise to release the pressure in the test configuration. Turn the APR handwheel fully counter-clockwise until zero pressure is indicated on the ETU display and then turn the test set control valve clockwise to the fully closed condition.
7. Repeat instructions 1 to 6 inclusive for all other gas systems.

C Gas Supply Block Dynamic and Static Output Test

1. Disconnect the pressure control tap adapter and adjustable pressure regulator from the gas test set illustrated on Fig. 6.1 to obtain the test configuration illustrated on Fig. 6.2.

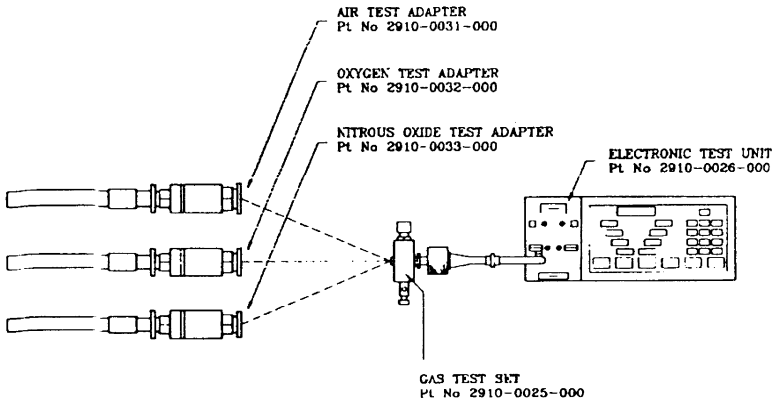


Fig 6.2 Testing Gas Supply System

*Dynamic and Static Output Test

2. Fit a full cylinder to the gas supply block under test, ensure that the gas test set control valve is fully open and open the cylinder valve.
3. Check that the gas supply system dynamic pressure conforms with the dynamic pressures provided as follows:

Gas	Dynamic Pressures	Static Pressures
Oxygen	Greater than 250kPa	320kPa Maximum
Nitrous Oxide	Greater than 250kPa	320kPa Maximum
Air	Greater than 250kPa	320kPa Maximum

4. Close the gas test set control valve and check that the regulator static pressure conforms with the static pressures provided in Instruction 3.
5. If the pressures do not conform, swap gauge.
6. Turn the adjustment screw clockwise to increase the pressure or counter-clockwise to decrease the pressure as required.
7. If the regulator cannot be adjusted to the correct pressure, carry out repairs on the regulator or fit a new unit.
8. Repeat the tests described in section E (Instructions 1 to 7 inclusive) for all other gas systems.
9. Disconnect the test configuration from the gas supply block outlet connection and refit the outlet tube.
10. When all tests are satisfactorily completed, close the cylinder valve and then open the gas test set control valve to release any pressure.

Note: Replace Regulator Seat and Diaphragm every two years.

6.6 Oxygen Gas Block System Leak Test

1. Disconnect inlet to oxygen rotameter and connect test set as illustrated on Fig. 6.3.
2. Fully open the O_2 cylinder valve.
3. Switch On/Off to ON.
4. Pressure stabilises, 1 minute test, less than 10kPa.
5. Bleed pressure at ventilator outlet. Turn OFF cylinder.
6. There should be no pressure drop on ETU.
7. This indicates the V8 does not leak.

6.7 On/Off Rotary Switch

1. Connect as per 6.6.1 & 6.6.2.
2. No pressure should register on the ETU.
3. Switch On/Off to ON.
4. ETU reads REG1 pressure.

Note: Ensure Reserve O_2 pressure is depleted before carrying out this test.

6.8 PS1 Set Pressure

1. Connect as per 6.6.1 to 6.6.4
2. Close cylinder valve.
3. Slowly bleed system pressure at ETU bleed valve.
4. Note pressure when O_2 fail condition occurs. Set to 220kPa nominal.

6.9 Reserve O_2 Regulator Set Pressure

1. As per 6.8.1 to 6.8.3.
2. Disregard O_2 failure alarm.
3. Note when ETU pressure stabilises.
4. ETU should read 220kPa.
5. Adjust Reg 4 if necessary and repeat Steps 1-4.

6.10 Power Outlet Flow Test Refer to Fig 6.10

1. Fit an oxygen adapter Part No. 2910-0047-000 to the flow test tube as illustrated on Fig. 3.21.
2. Turn OFF the ON/OFF switch and connect the free end of the oxygen adapter into the oxygen power outlet.
3. Check that the flow from the oxygen power outlet indicated on the ETU exceeds 100 lpm for Pipeline and 120 for Cylinder.
4. If the power outlet fails the flow test, check for occlusions in the fitting and pipework or fit a new outlet and repeat the test. Remove the test configuration.

6.10 N_2O Gas Block System Leak Test

1. Connect as per Fig. 3.6 to N_2O test point.
2. Ensure O_2 supply fitted, On/Off is ON and N_2O is selected.
3. Open N_2O cylinder valve.
4. When ETU stabilised, close cylinder valve.
5. Less than 10kPa in one minutes.

6.11 Vaporiser Manifold Mechanical Checks

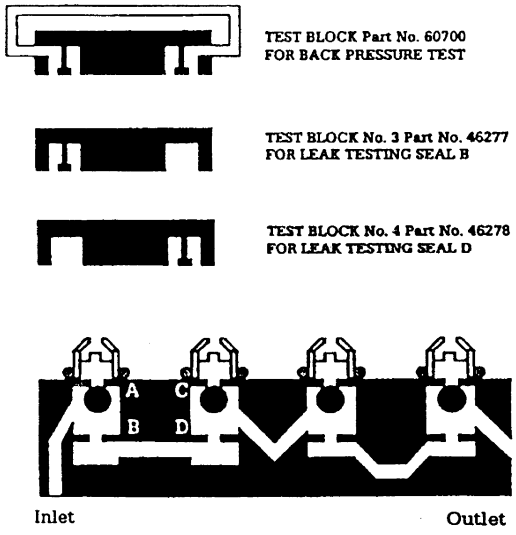
1. Inspect the manifold assembly for signs of mechanical damage and security of attachment.
2. Check the port valve cartridges for damage and security of attachment and fit new vaporiser sealing 'O' rings.
3. Check that the port valves are securely in place and not loose.
4. Check the plungers for free movement between fully open to fully closed.

6.12 Pressure Relief Valve Setting Check

Patient Pressure Safety Valve Check

1. Set all flow tubes to zero flow.
2. Connect ETU tester as in Fig. 6.4.
3. Slowly turn oxygen flowtube ON until the Patient pressure relief valve opens. The reading on the ETU should be 50cmH_2O.
4. Replace or repair safety valve if safety valve does not relieve at 60cmH_2O.

Fig 6.3 Test Blocks



D Vaporiser Manifold Leak Tests

(Connect ETU test as in Fig. 6.4)

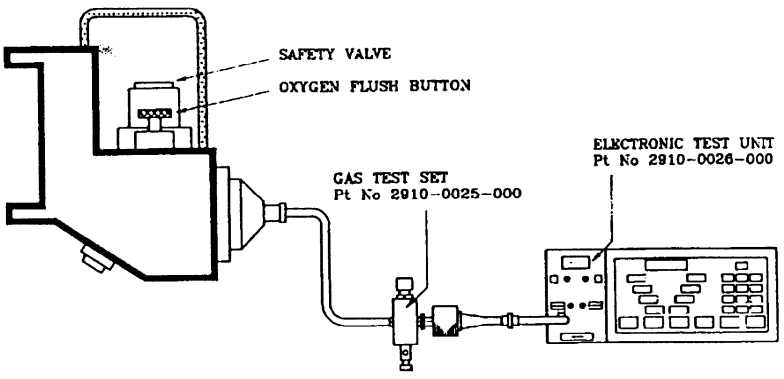
1. Remove GPO panel.
2. Disconnect vaporiser manifold inlet hose.
3. Fit the test configuration as illustrated on Fig. 6.4 and occlude the common gas outlet.
4. Fit Test Block No. 3, illustrated on Fig 6.3, to the left hand pair of port valves and pressurise the manifold to 20 kPa. Shut off the pressure and check that the pressure indicated on the ETU does not decrease by more than 2 kPa over a time period of 1 minute.
5. Release the pressure, fit Test Block No. 3 to the right hand pair of port valves and repeat the test described in Instruction 2.
6. Repeat the tests described in Instruction 4 and 5 using Test Block No. 4 in place of Test Block No. 3 and if any leaks are found in any test renew the appropriate port valve cartridge.
7. Remove Test Block No. 4 and repeat the test and if any leak is found it is likely to be in the common gas outlet block. Rectify any leak and repeat the test described in Instruction 4.
8. Fit a Test Block Part No. 607000 to each of the vaporiser mounting positions in turn and pass an oxygen flow of 8 lpm through the unit.
9. Check that the maximum indication on the ETU does not exceed 6.7 kPa. If this pressure is exceeded the port valve upper seals may be leaking therefore renew the port valve cartridge assemblies and repeat the test.
10. Remove the Test Block and repeat the test. If the test pressure of 6.7 kPa is exceeded the port valve upper seals may be leaking or there may be a restriction in the internal passages, therefore renew the port valve cartridge assemblies and turn the ON/OFF switch to OFF.

6.13 Leak test

(Flowmeters to FGO)

Connect pressure meter to FGO of GEM™9100, set 100 lpm oxygen flow by adjusting the fine adjustment valve on the rotameter back. Plug the FGO and observe the pressure meter. A pressure of >30cmH_2O must be obtained. Should this be less, then check all connections and tubing for leaks.

Fig 6.4 Pressure Relief Valve Leak Test Configuration



© Copyright 1993 – Iss/Rev A/0 –

6.14 Port Valve Servicing

Note: Complete disassembly and service of a Port Valve should only be carried out at the Service Centre where spares and suitable test equipment will be obtainable. Return replaced valve to Sydney for service and use as change over valve in future.

Port Valve Renewal - 512355

1. Remove the manifold rear panel.
2. Disconnect connecting pipes at the bottom face of the valve.
3. Remove 'O' ring and two fixing screws on top face of manifold.
4. Remove valve assembly.
5. Renewal - fit the Port Valve in reverse order to removal.

Note: When replacing connecting pillars, re-seal thread with 'Loctite' Hydraulic seal. Care should be taken to remove loose particles that may have been left by previous assembly to prevent leaks and blockages.

When the pipes are re-connected ensure that none of the pipes are kinked. The pipes should be positioned so that they do not pass immediately behind any of the brackets fixing points.

6. Refit rear panel.
7. Test for cross leaks.
8. Carry out a Back Pressure Test.

Fig 6.5 Port Valve

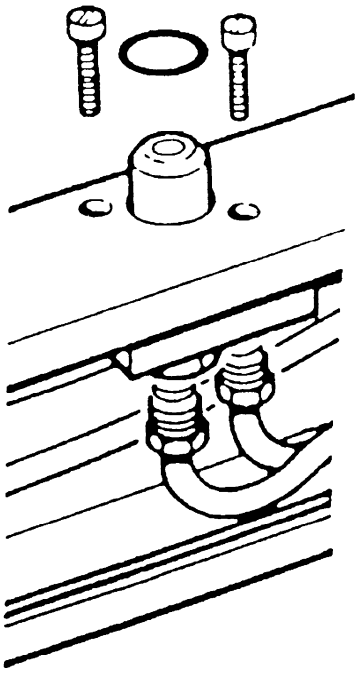
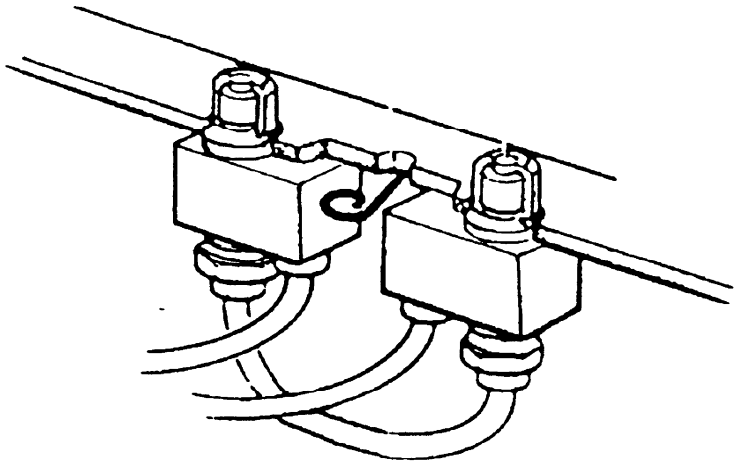


Fig 6.6 Locking Lever Retention Spring Renewal



6.15 Fault Finding Guide

Symptom

1. Leak at Port Valve Seals
2. Leaks around Port Valve
3. Overall Leaks
4. Low Flow when vaporiser is fitted

Possible Cause

a) Faulty Port Valve
a) Rest Pad or Button
b) Vaporiser Plug - on block adjustment
c) Vaporiser locking Lever Retention Spring
d) Vaporiser locking Lever Spindle claws damaged/worn
e) Port Valve 'O' Ring
a) Associated equipment
b) Internal pipe assemblies-connection
a) Port Valve Seals
b) Leak
c) Vaporiser Plug - block plunger is not operating Port Valves
d) Internal pipes constriction

© Copyright 1993 – Iss/Rev A/0 –

Check/Remedy

a) Exchange Port Valve
a) Check and adjust setting as necessary
b) Check and adjust setting as necessary. See Vaporiser Service Manual
c) Check and renew as necessary
d) Check and renew as necessary. See Vaporiser Service Manual
e) Renew
a) Isolate associated equipment
b) Remove rear panel, check for leaks using detecting fluid - repair as necessary
a) Check external 'O' Ring - renew as necessary
b) Check for leaks
c) Fit another Vaporiser - if better, the Vaporiser plunger is faulty. If no better, exchange Port Valve
d) Remove rear panel, check for any impingement on pipe assemblies

6.16 Oxygen Flush Valve Test

1. Connect for normal operation.
2. Select oxygen on the ETU, select and fit flow element 2 and zero the ETU. Connect the ETU configuration to the common gas outlet.
3. Press the oxygen flush button and check that the flow from the oxygen flush outlet indicated on the ETU is greater than 35 lpm and then release the oxygen flush button.
4. If a flow of between 35 and 75 lpm cannot be achieved, fit a new Schraeder valve in the common gas outlet block.
5. When all tests are completed, disconnect the test configuration.

Fig 6.9 Oxygen Flush Valve Test

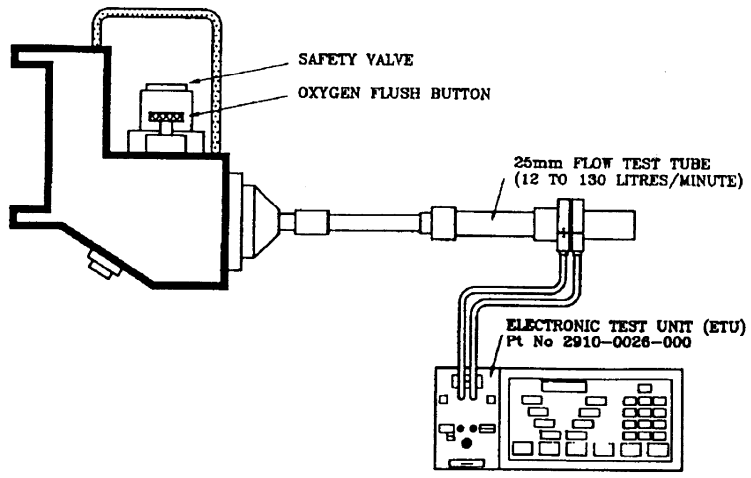
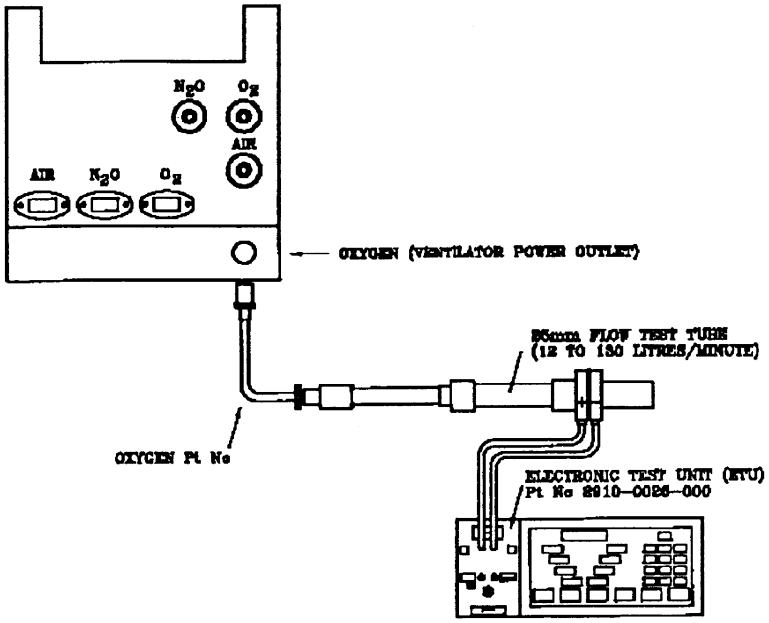


Fig. 6.10 Power Outlet Flow Test



6.17 Oxygen Analyser Test

Table 6.1 Oxygen Analyser Test

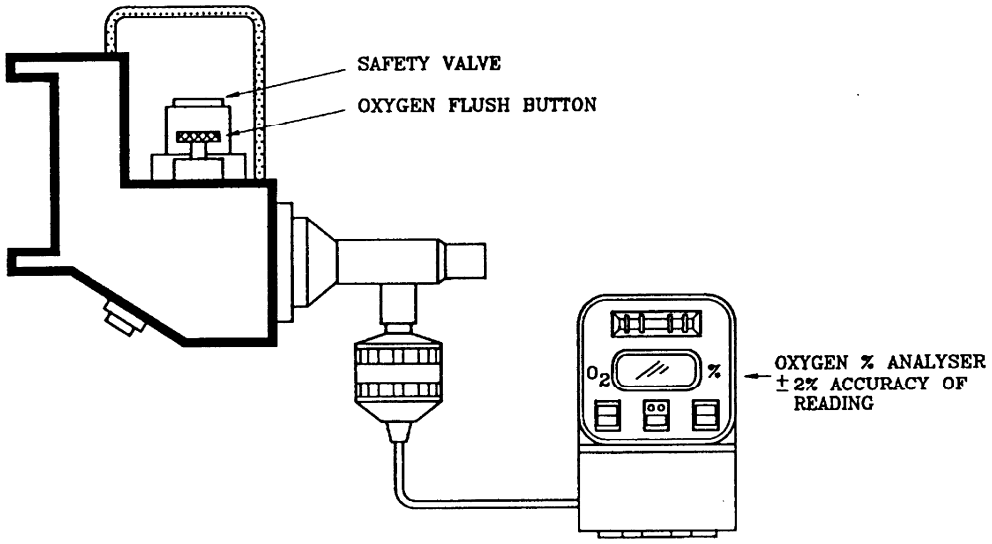
Flowtubes (LPM)		Monitor		Analyser	
O_2	N_2O	Min	Max	Min	Max
0.0	10.0			0	0
0.5	9.5			3	8
1.0	9.0			8	12
2.0	8.0	18	22	18	22
4.0	4.0	49	52	48	52
8.0	2.0	78	82	78	82
8.0	1.5	89	93	89	93
8.0	0.5	92	96	93	96
8.0	0.0	98	100	98	100

Table 6.2 Air/Oxygen Table

Flowtubes (LPM)		Monitor		Analyser	
O_2	Air	Min	Max	Min	Max
0.0	10.0	19	23	19	23
0.5	9.5	24	28	24	28
2.0	8.0	35	39	35	39
4.0	4.0	58	62	58	62
8.0	2.0	83	87	83	87
9.5	0.5	93	97	93	97
10.0	0.0	98	100	98	100

© Copyright 1993 – Iss/Rev A/0 –

Fig. 6.11 Oxygen Analyser Test Configuration.



1. Connect as per Fig. 6.11.
2. Select N_2O.
3. Set flows as per Table 6.1 and ensure Analyser and Monitor readings are as shown.
4. Select Air.
5. Repeat Step 3 using Table 6.2.

Note: Allow 30 seconds for readings to stabilise after changing rotameter settings.

6.18 PS2 Set Pressure

1. As per 6.10.1 to 6.10.4.
2. Slowly bleed at ETU.
3. Note pressure when N_2O fail alarm occurs (220kPa nominal).

6.19 Air Gas Block System Leak Test

1. Connect as per Fig. 3.6 to Air test point.
2. Ensure O_2 supply fitted, On/Off is ON and Air is selected.
3. Open Air cylinder valve.
4. When ETU stabilises, close cylinder valve.
5. Less than 10kPa/min.

6.20 PS3 Set Point

1. As per 7.2.1 to 7.2.4.
2. Slowly bleed at ETU.
3. Note pressure when Air fail alarm occurs (220kPa nominal).

6.21 O_2 Failure Operational Check

1. Connect for normal operation.
2. Select N_2O (checking SOL2)
3. Set O_2 and N_2O Rotameter at 1/2 scale.
4. Close O_2 cylinder valve.
5. When O_2 fall occurs ensure:
   a. N_2O supply ceases.
   b. N_2O and O_2 rotameter back lights extinguish.
   c. O_2 supply continues at 2LPM.
6. Open O_2 cylinder valve.
7. System returns to normal operation.
8. Select Air (checking SOL3)
9. Repeat Steps 4 to 7 substituting Air for N_2O. (Except Air rotameter does not cut off).

6.22 AC & DC power Failure (SOL1)

1. Connect for normal operation.
2. Disconnect battery +'ve terminal.
3. Disconnect AC power supply.
4. An audible gas operated alarm must be heard.

6.23 GEM 125 Test Procedure

1. Configure for normal operation of GEM.
2. Supply O_2, NO.
3. On/Off to ON.
4. All 7 LEDs illuminate and post preformed.
5. O_2 monitor reads current O_2 percentage.
6. Select Air - Air Fail
   - N_2O & Air back lights OFF.
   a. Press mute - 30 seconds timeout.
7. Turn ON Air supply - Air fail OFF.
   - Air back light ON.
8. Select N_2O - N_2O back light ON.
9. N_2O supply OFF.
10. Bleed N_2O ensuring O_2 monitor keeps above 25%
    - N_2O fail
    - N_2O back light OFF.
11. N_2O supply ON.
12. O_2 supply OFF.
13. Bleed O_2 - O_2 fail.
    - O_2 and N_2O back lights OFF.
14. O_2 supply ON.
15. Set O_2 rotameter at 0.5 LPM and N_2O at 2 LPM.
    - Monitor reads 20% within 90 seconds.
    - Low O_2 alarm at 23% set point.
    - Low O_2 alarm should sound.

© Copyright 1993 – Iss/Rev A/0 –

16. Increase N_2O rotameter to 3 lpm.
    - N_2O cut OFF 5 seconds after monitor passes 18%.
    - Low O_2 alarm ceases as monitor rises above 25%.
    - N_2O restored 15 seconds after monitor rises above 19%.
17. System restored to normal operation.

6.24 Electrical Safety

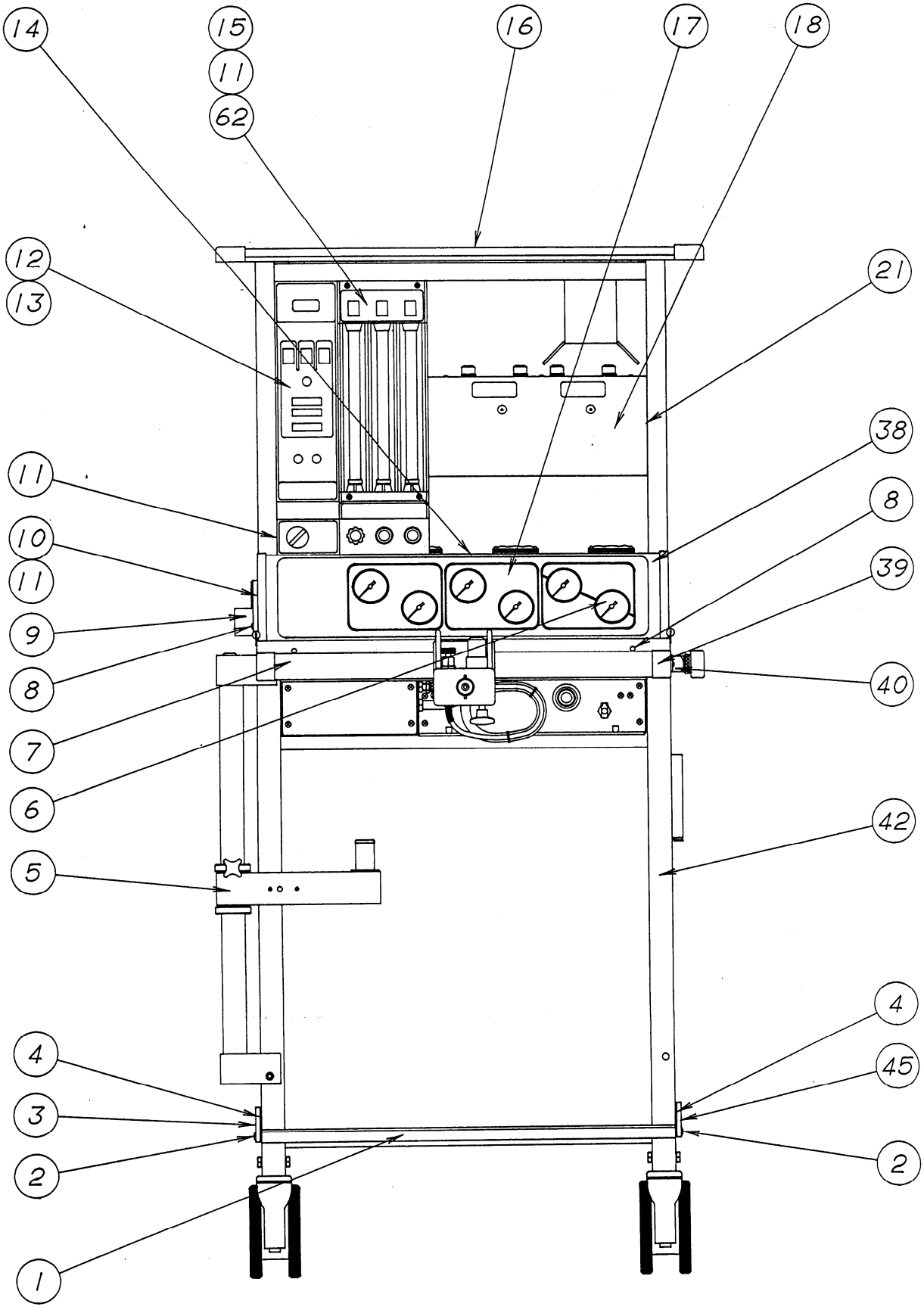
1. Inspect power lead and GPO's for damage.
2. Ensure all 6 GPOs and power pack On/Off LEDs illuminate when AC supplied.
3. Perform electrical safety tests as per AS3551
    - earth resistance < 0.2 Ohm
    - return earth leakage < 500 micro amps

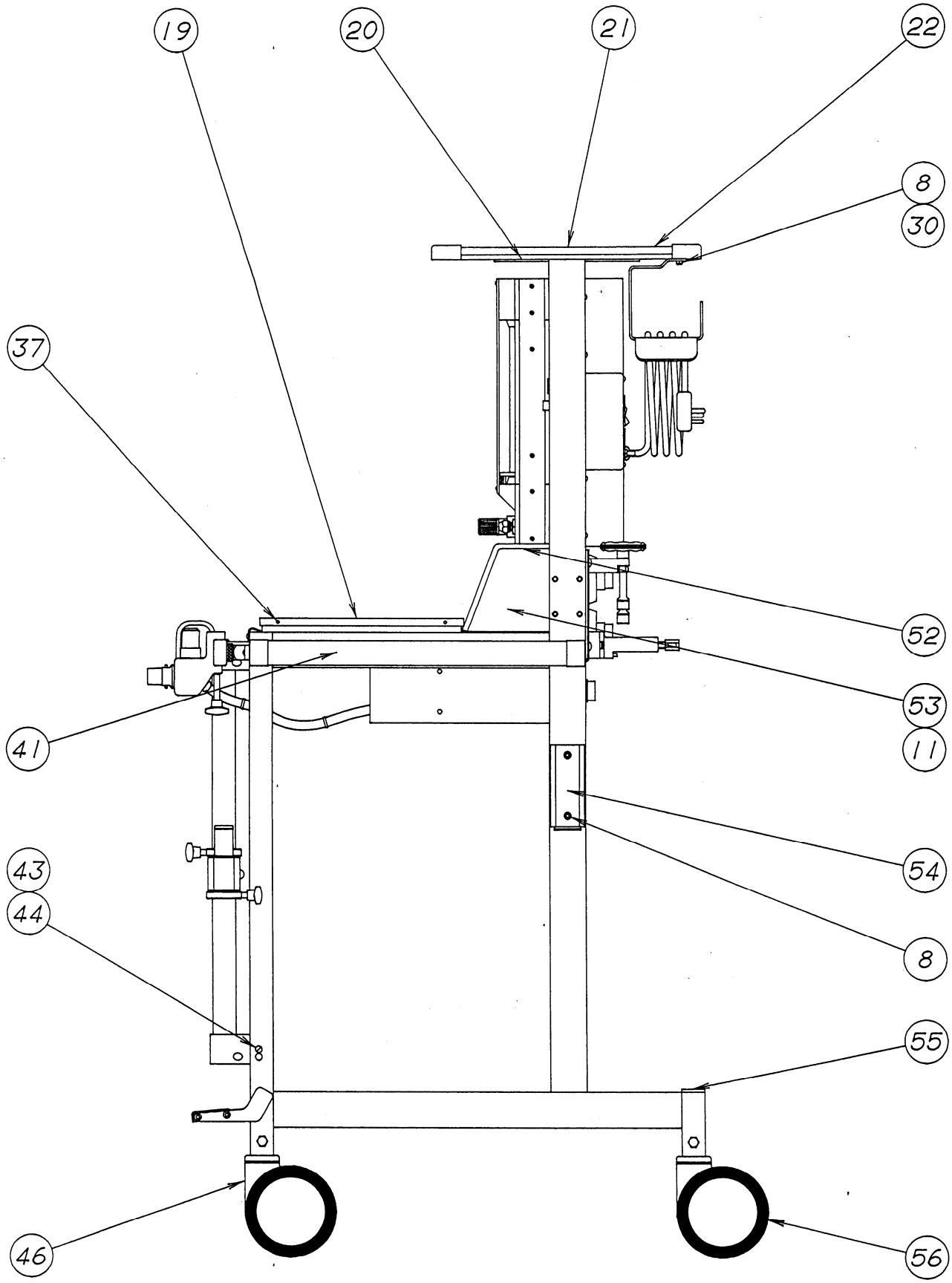
 © Copyright 1993

7.0 Spare Parts List

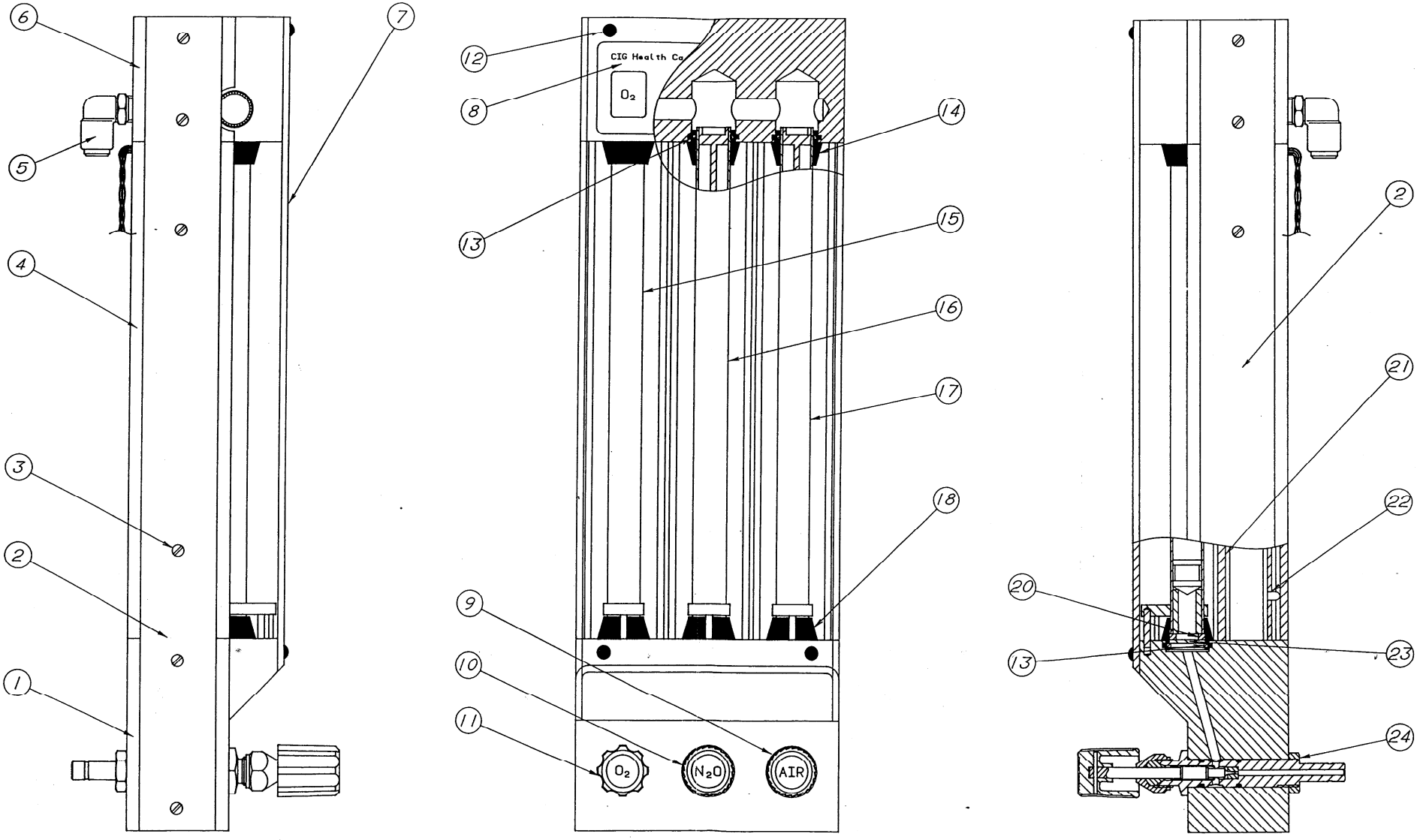
Item No: 512500

LV	Pref	Component Item No.	Description	Quantity Per Assembly	UM	Item Type	P H
01	1	512481	Pedal Brake Assembly	1.00000	Ea	1	
01	2	7950226	Screw But HD Chrome M6X10	4.00000	Ea	4	
01	3	512483	Bracket Brake Assy L/H	1.00000	Ea	4	
01	4	512486	Washer Dia 25mm	2.00000	Ea	2	
01	5	512540	Arm Absorber Assy GEM™9100	1.00000	Ea	1	P
01	6	512639	Cover Gauge Top Panel	6.00000	Ea	4	
01	7	512498	Multerail Front GEM™9100	1.00000	Ea	2	
01	8	7950243	Screw But Hd Chrome M5X12	12.00000	Ea	4	
01	9	512659	Bracket Ventilator GEM	1.00000	Ea	1	
01	10	512682	Cover Plate Side L/H	1.00000	Ea	2	
01	11	7950233	Screw But Hd Skt M5X12Bl	21.00000	Ea	4	
01	12	512640	Low Oxygen Monitor GMS125	1.00000	EA	4	
01	13	7950146	Screw Pan Hd M5x8	3.00000	Ea	4	
01	14	7970281	Extrusion Jehbsil 534	0.50500	Me	3	
01	15	512590	Rotameter 02/N20/Air	1.00000	Ea	1	P
01	16	522011	Label Maximum Load 20Kg	1.00000	Ea	4	
01	17	521997	Label GEM™9100 Facia	1.00000	Ea	4	
01	18	512610	Module Back Bar GEM™9100	1.00000	Ea	1	P
01	19	512507	Beading Top Tray	2.00000	Ea	2	
01	20	512551	Bracket Support O/H Shelf	2.00000	Ea	2	
01	21	7950239	Screw But Head Chro M8X16	12.00000	Ea	4	
01	22	512570	Overhead Shelf Assembly	1.00000	Ea	1	P
01	23	7995268	Cap Plasti-Rect 2146	2.00000	Ea	4	
01	24	512633	Bracket Hose Management	2.00000	Ea	2	
01	25	512614	Cover Plate Top	1.00000	Ea	2	
01	26	322000	Label Anaesthetic Machine	1.00000	Ea	4	
01	27	512611	Support Backbar Top	1.00000	Ea	2	
01	28	512612	Support Backbar Bottom	1.00000	Ea	3	
01	29	522006	Label Low Oxygen Monitor	1.00000	Ea	4	
01	30	7958043	Nut Nylon M5	8.00000	Ea	4	
01	31	512615	Cover Plate Bottom	1.00000	Ea	2	
01	32	512613	Bracket Support Cover	1.00000	Ea	2	
01	33	NB556	Retainer Spire SNU1747	3.00000	Ea	4	
01	34	7950244	Screw P/N Hd 10ABX5/8 STST	3.00000	Ea	4	
01	35	7950241	Screw Skt Hd Cap M6X1X16	4.00000	Ea	4	
01	36	512715	Scav Flow/Interface Assy	1.00000	Ea	1	
01	37	NB459	Screw Grub 3/16" - 32X5LG	4.00000	Ea	4	
01	38	512605	Tray Top GEM™9100	1.00000	Ea	2	
01	39	512472	End Cap Multerail	6.00000	Ea	4	
01	40	512475	Bracket Multerail GEM™9100	6.00000	Ea	4	
01	41	512499	Multerail Side GEM™9100	2.00000	Ea	2	
01	42	512617	Frame Assembly GEM™9100	1.00000	Ea	1	P
01	43	NB355	Screw Csk 1/8BSWX1/4CAD	4.00000	Ea	4	


14
15
11
62
16
17
18
12
13
21
38
11
8
10
11
39
9
8
40
7
6
42
5
4
4
45
3
2
2
1


19
20
21
22
8
30
37
52
53
41
11
54
43
44
8
55
46
56

11
51
50
61
49
48
47
23
24
25
26
21
35
34
33
21
32
31
30
11
29
28
27
24



ROTAMETER BLOCK

TEST INSTRUCTIONS

1/ CHECK FOR CORRECT AND SOUND ASSEMBLY.

2/ ADJUST GLAND NUT AFTER BEDDING IN SPINDLE. THE VALVE ACTION MUST BE SMOOTH AND FREE FROM BUMPING.

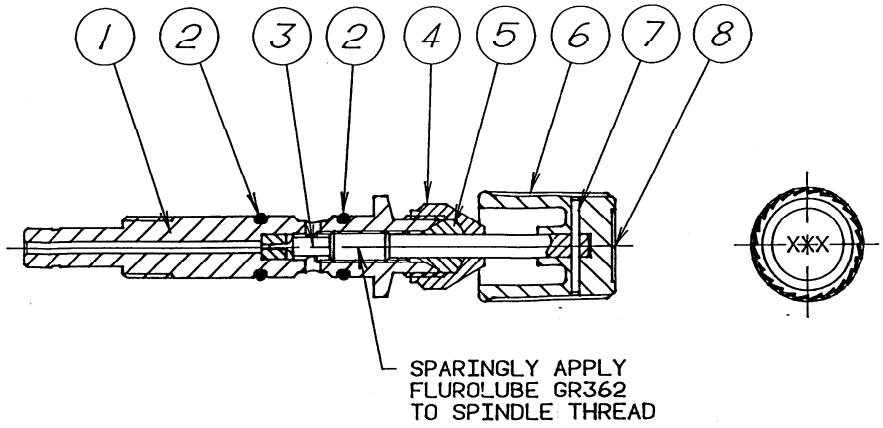
3/ CHECK VALVE FOR A POSATIVE SHUT OFF.

4/ FOR TESTING USE AN OXYGEN FLOWMETER WITH A FLOW RANGE OF 100ml/min - 8l/min.

5/ CONNECT THE VALVE ASSEMBLY TO A 400kPa OXYGEN SUPPLY. WITH VALVE OPEN, CHECK FOR LEAKS FROM GLAND AT 40cm/H2O PRESSURE.

6/ OPEN THE VALVE AND CHECK THAT THE BOBBIN RISES OFF THE REST, ROTATES AND MOVES OVER THE FULL LENGTH OF THE GRADUATED SCALE. CHECK SHUT OFF - NO LEAKS ALLOWED.

7/ ADJUST CONTROL KNOB TO A FLOW OF 1.5l/min. WITHOUT ALTERING THE SETTING, ALTERNATELY PUSH AND PULL THE CONTROL KNOB. THE INDICATED FLOW RATE MUST NOT VARY MORE THAN ±150ml/min.



NOTE - WITH THE FLATS OF THE HEXAGON ON THE HOUSING IN LINE WITH THE HORIZONTAL AXIS AND THE SPINDLE FULLY SHUT OFF, POSITION LABEL ON THE KNOB WITH LETTERING IN AN UPRIGHT POSITION AS SHOWN.

ASSY. NO.	ITEM 1	ITEM 6	ITEM 8
512577	512574	515839	521993
512578	512575	515809	521992
512579	512576	512493	521991

ITEM NO.	DESCRIPTION	REQ'D	MAT'L/PART NO.
8	LABEL KNOB	1	REF. CHART
7	ROLL PIN	1	515811
6	KNOB ROTAMETER	1	REF. CHART
5	NUT GLAND	1	FJ301
4	NUT	1	FJ300
3	SPINDLE ROTAMETER	1	512573
2	O-RING 012 NEOP 65/75	2	7964105
1	HOUSING SPINDLE	1	REF. CHART

1:1 MJH 18/4/91

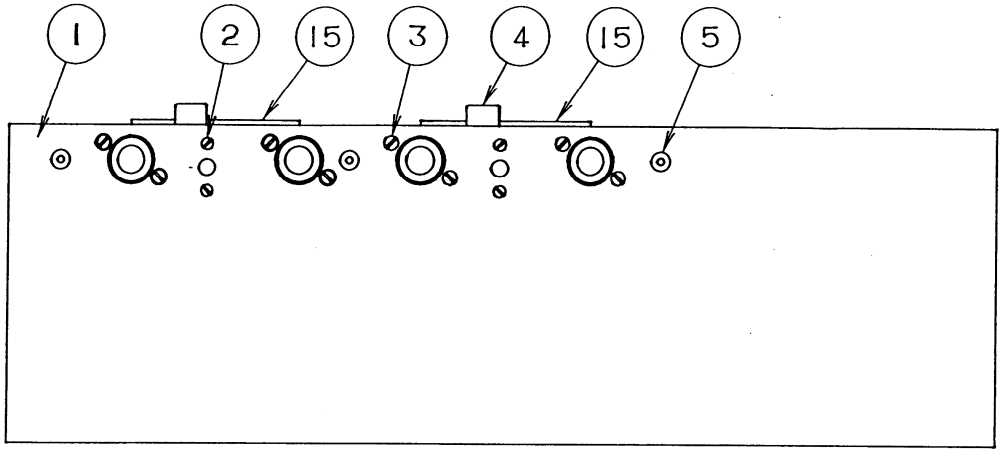
ASSY FLOW CONTROL VALVE

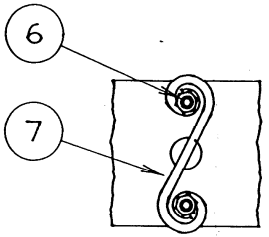
(SIMILAR TO FJ297)

512577/9

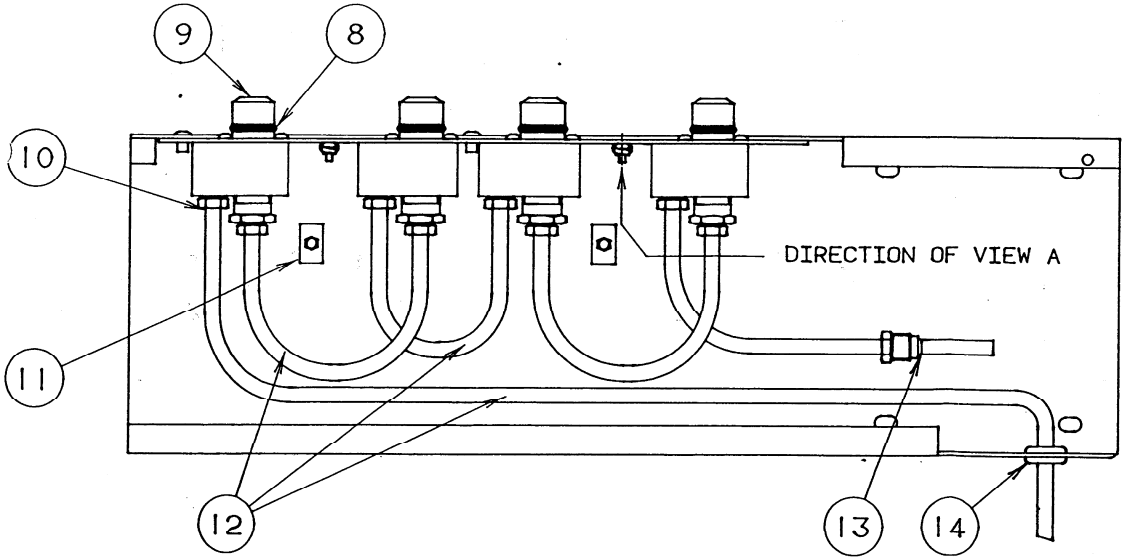
2
1 1

LABELS UPDATED G00666/219/9/91
NEW RELEASE G00833/118/4/91

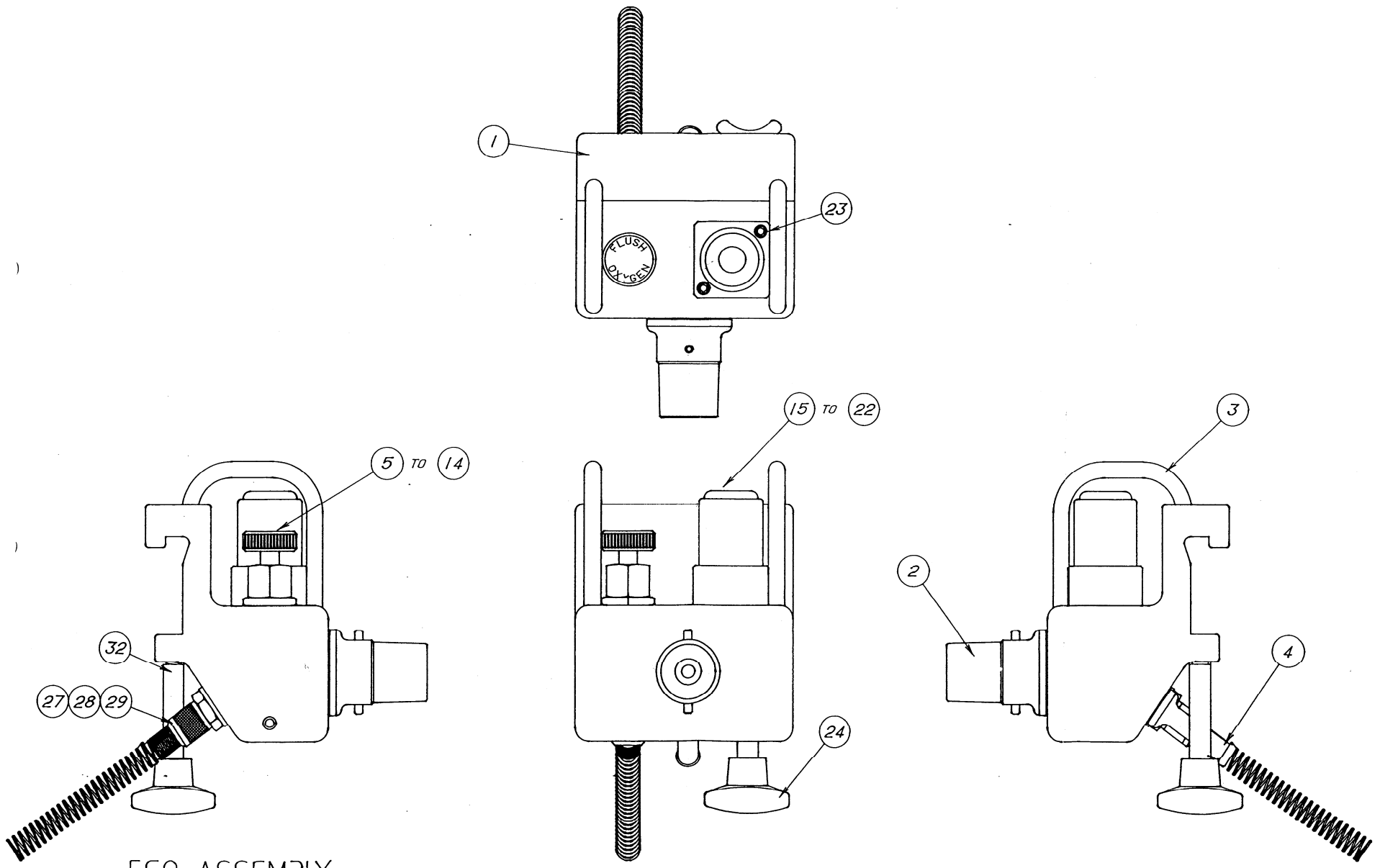




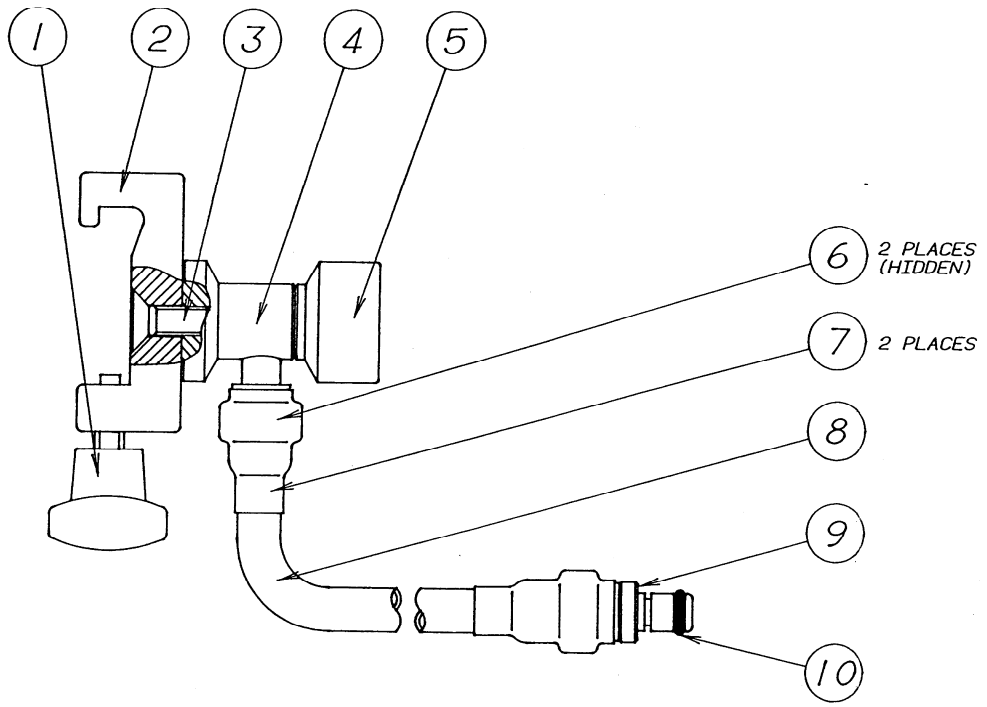
VIEW "A"



ITEM NO.	DESCRIPTION	REQ'D	MAT'L/PART NO.
15	LABEL BACKBAR	2	512534
14	GROMMET RUBBER 5 ID G85	1	7970279
13	SLEEVE TUBING 1/4 OD	10	7968042
12	HOSE TUBING 1/4 OD	1 ME	7970276
11	PUSH ON FIX 4.8MM	2	512350
10	NUT TUBING 1/4 ID	10	7968043
9	VALVE ASSEMBLY BACK BAR	4	512355
8	O-RING 1132 NEOP65/75	4	7964030
7	SPRING RETAINING	2	512349
6	NUT MSBR M2.5 ZINC PLATED	4	7958047
5	RIVET POP 3/16 73STS6-2	3	7962019
4	REST NYLON BACK BAR	2	512332
3	SCREW PAN HD M3X5	6	7950066
2	SCREW PAN HD 2.5 ZINC PL	4	7950214
1	BACK BAR ULTIMA	1	512518



FGO ASSEMBLY



NOTES

1/ SCREW KNOB (ITEM 1) INTO BRACKET (ITEM 2) AS SHOWN.

2/ ENSURE NIPPLE ON BODY (ITEM 4) IS IN A VERTICAL DOWNWARD POSITION AS SHOWN. SECURE BODY TO BRACKET USING SCREW (ITEM 3). USE LOCTITE 262 TO SECURE SCREW IN POSITION.

3/ APPLY LOCTITE 680 TO THE BASE OF THE THREAD ON BODY, SCREW SLEEVE (ITEM 5) IN POSITION AGAINST BODY (ENSURE NO LOCTITE IS ON EXPOSED AREA OF THREAD).

4/ PLACE CLIP (ITEM 6) AND HEAT SHRINK TUBE (ITEM 7) OVER HOSE (ITEM 8). POSITION HOSE OVER NIPPLE AND SECURE IN PLACE WITH CLIP. POSITION HEAT SHRINK TUBE OVER CLIP AND APPLY HEAT TO SECURE.

5/ PLACE 'O'RING (ITEM 10) IN POSITION OVER ADAPTOR (ITEM 9). USING SAME PROCESS AS PER NOTE 4, SECURE ADAPTOR IN PLACE.

6/ CHECK FINAL ASSEMBLY TO ENSURE NO LEAKS, THEN PLACE IN PLASTIC BAG (ITEM 11) AND SEAL. PRINT PART NUMBER AND DATE ON LABEL AND ADHERE TO BAG.

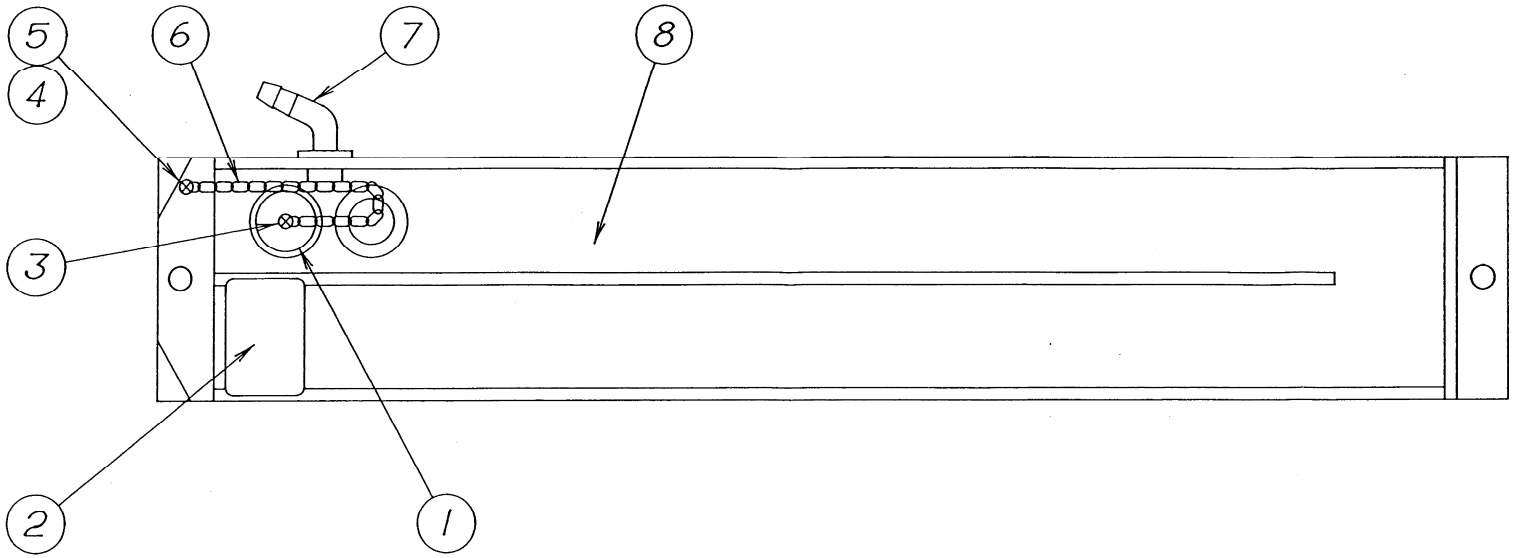
ITEM NO.	DESCRIPTION	REQ'D	MAT'L/PART NO.
11	PRINTED PLASTIC BAG	1	521607
10	O-RING 008 NEOP 65/75	1	7964100
9	ADAPTOR Q/CONN FITTING	1	512677
8	TUBE OXYGEN	0.75	518403
7	TUBE H/SHRINK WHT DIA 19	0.06	7970271
6	O-CLIP 9-11MM BULK 0911	2	OTK1011B
5	SLEEVE DISS 02	1	518466
4	BODY/NIPPLE ASSY BRAZED	1	512679
3	SCREW C'SNK HD M6X16	1	7950242
2	BRACKET MULTERAIL MACHINED	1	512688
1	KNOB SHORT GEM 9100	1	512554

1:1 MJH 15/10/91

AUXILIARY OXYGEN OUTLET

512705

NEW RELEASE G00694/1 15/10/91



NOTES

1/ APPLY A SMALL AMOUNT OF LOCTITE 222 TO THREAD OF SCREW (ITEM 5) THEN SCREW IN POSITION WITH NUT (ITEM 4). ENSURE CHAIN (ITEM 6) IS ATTACHED AS SHOWN.

2/ APPLY 24 HOUR ARALDITE TO THREAD OF NIPPLE (ITEM 7) AND SCREW FIRMLY IN POSITION AS SHOWN.

3/ ATTACH LABEL (ITEM 2) TO INTERFACE (ITEM 8) IN POSITION AS SHOWN.

4/ ENSURE INTERFACE IS KEPT FREE FROM SCRATCHES, MARKS, ETC.

ITEM NO.	DESCRIPTION	REQ'D	MAT'L/PART NO.
8	SCAV INTERFACE PURCHASED	1	512692
7	NIPP HOSE BENT 3/8"-24EXT	1	M701
6	CHAIN BRASS	0.135	M80R
5	SCREW PAN HD M2.5X8 NI PL	1	7950214
4	NUT MSBR M2.5 ZINC PL	1	7958047
3	SCREW 5/16" X NO.4 B	1	NB1222
2	LABEL SCAVENGE INTERFACE	1	522009
1	PLUG BLANKING	1	511813

1:2 MJH 17/12/91

SCAV INTERFACE GEM 9100

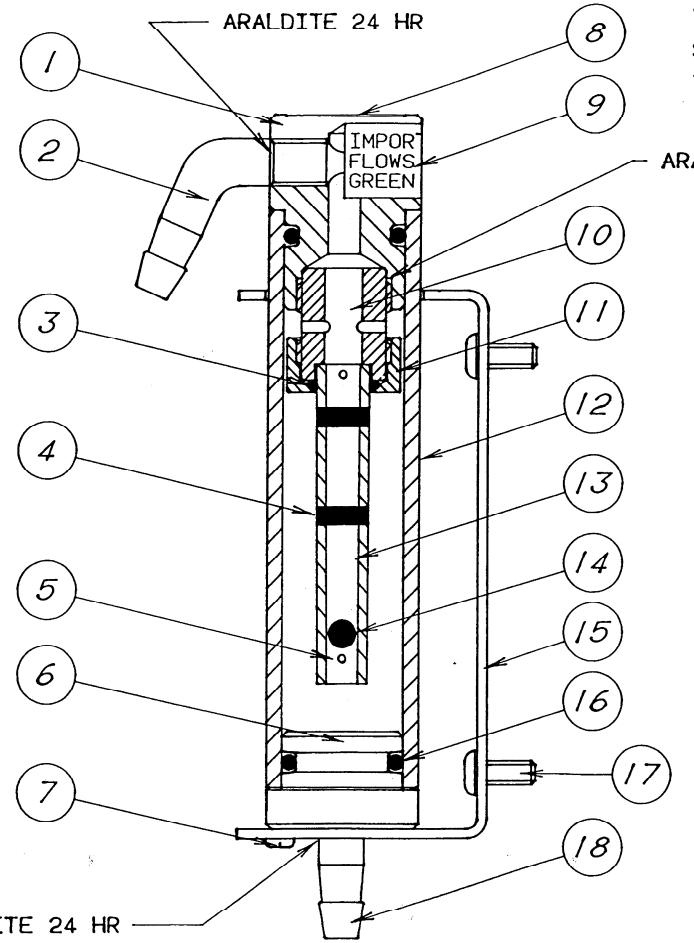
512660

512662

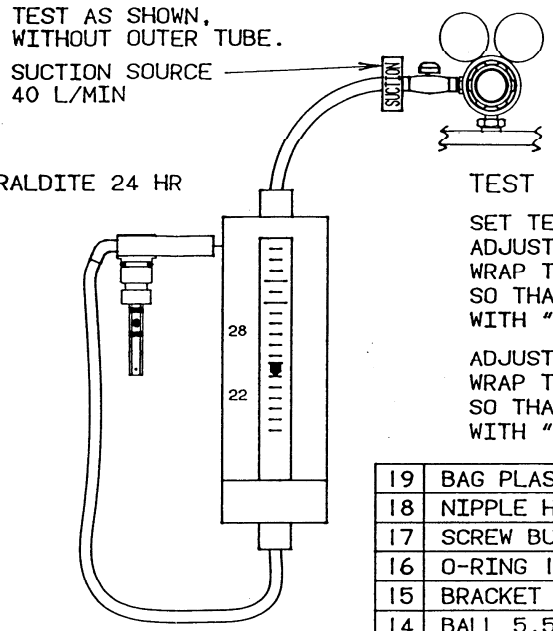
2

1 1

DRAWING RELEASED G01057/2 17/12/91



NOTE - PLACE FINAL ASSEMBLY IN PLASTIC BAG (ITEM 19) AND HEAT SEAL.



TEST PROCEDURE:

SET TEST EQUIPMENT AS SHOWN
ADJUST SUCTION FLOW TO GIVE 28 L/MIN
WRAP TAPE (ITEM 4)AROUND TUBE (ITEM 12)
SO THAT,BOTTOM EDGE OF TAPE IS LEVEL
WITH "TOP EDGE"OF BALL.

ADJUST SUCTION FLOW TO GIVE 22 L/MIN
WRAP TAPE (ITEM 4)AROUND TUBE (ITEM 12)
SO THAT,TOP EDGE OF TAPE IS LEVEL
WITH "BOTTOM EDGE"OF BALL.

ITEM NO.	DESCRIPTION	REQ'D	MAT'L/PART NO.
19	BAG PLASTIC PRINTED	1	521607
18	NIPPLE HOSE SUCTION	1	517630
17	SCREW BUTTON M5X12	2	7950243
16	O-RING 115 NEOP65/75	2	7964108
15	BRACKET SCAVENGE BENT	1	512687
14	BALL 5.5 STST	1	415745
13	TUBE MOULDED MACHINED	1	512673
12	TUBE EXTERNAL	1	512672
11	NUT RETAINING FLOWMETER	1	512674
10	RETAINER FLOWMETER	1	512042
9	LABEL INSTRUCTION	1	521840
8	LABEL SCAVENGE FLOWMETER	1	522010
7	SCREW PAN HD M3X8	1	7950022
6	END CAP FLOWMETER	1	512669
5	PIN SPIROL ø1/6"X 3/8" STST	2	NB1553
4	TAPE PIN STRIPING GREEN	0.1ME	7995227
3	O-RING 111 NEOP65/75	1	7964026
2	NIPPLE HOSE BENT 3/8-24	1	M701
1	HEAD,TUBE FLOWMETER	1	512668

1:1 S.M. 24/10/91

512660

FLOWMETER SCAVENGE GEM 9100

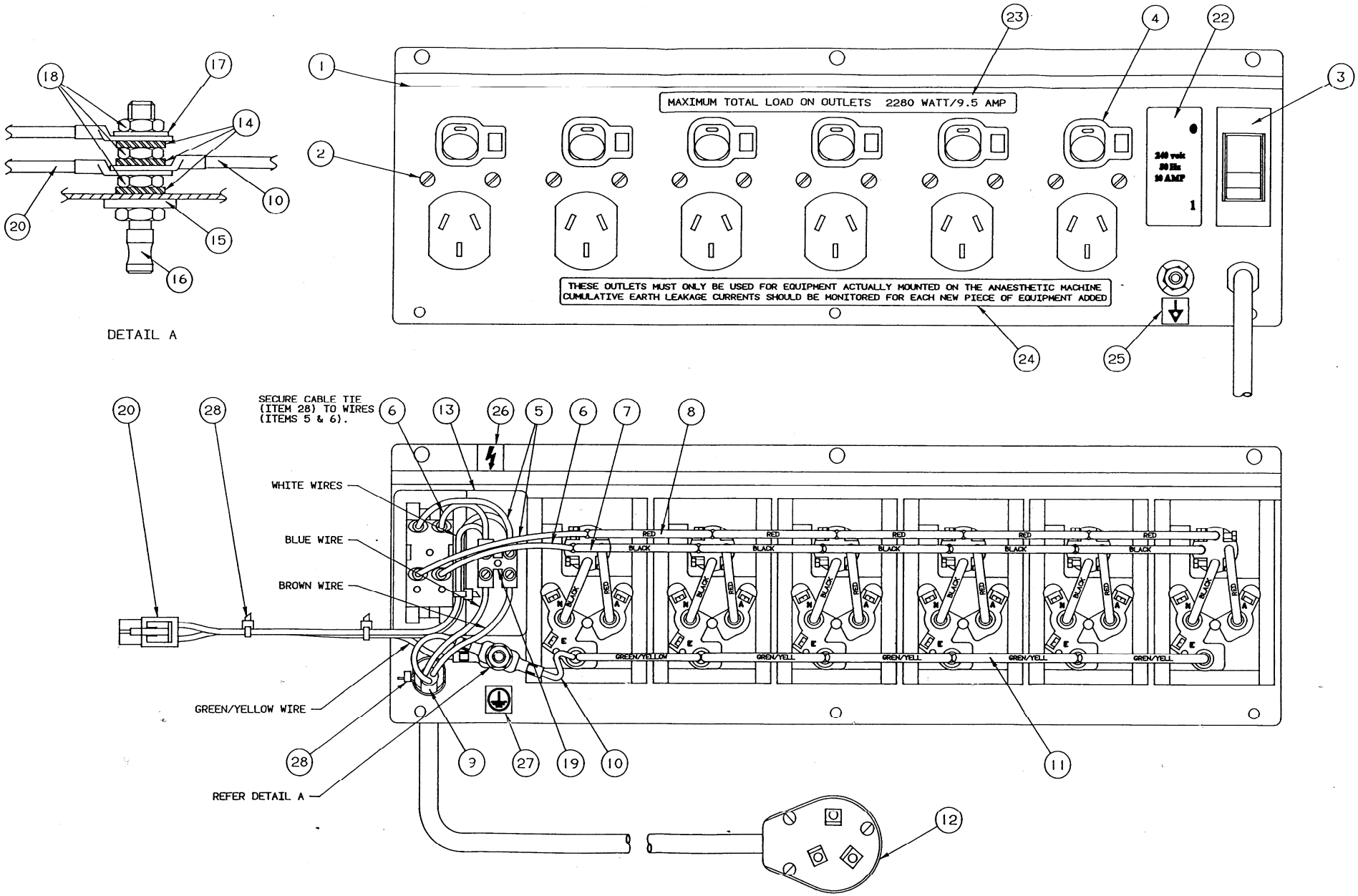
512661

2

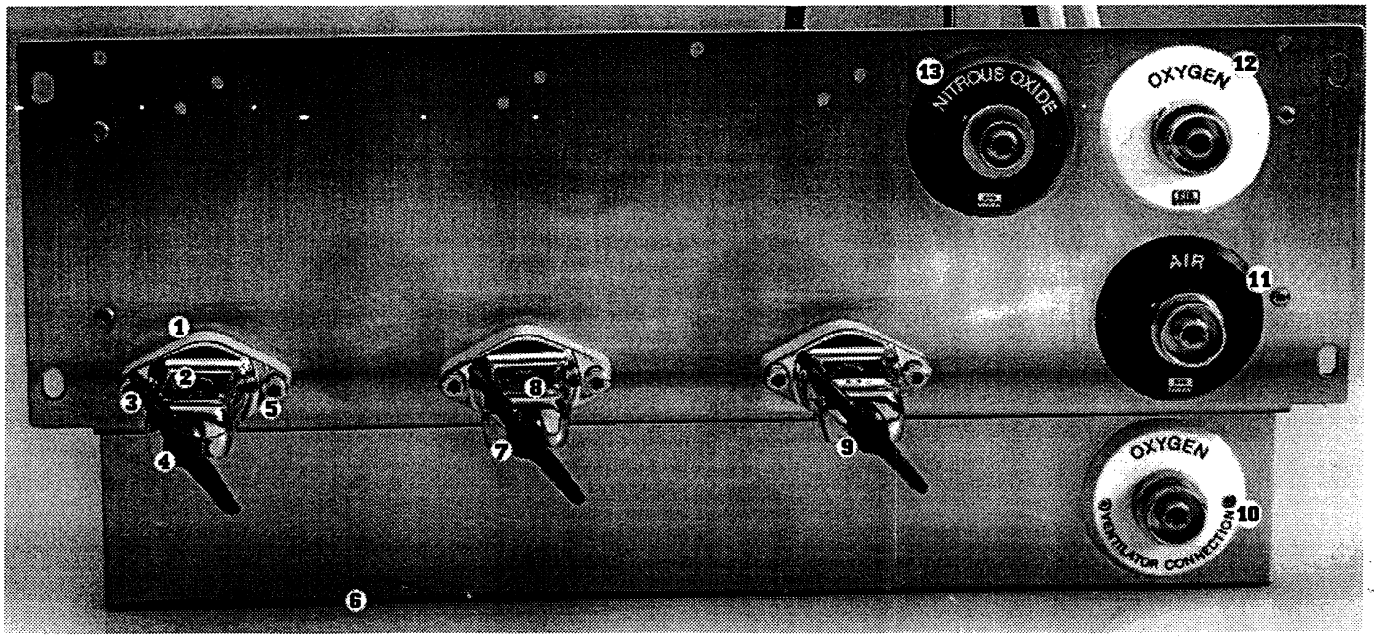
1 1

521607 X 1 ADDED GQ1057/2 17/12/91

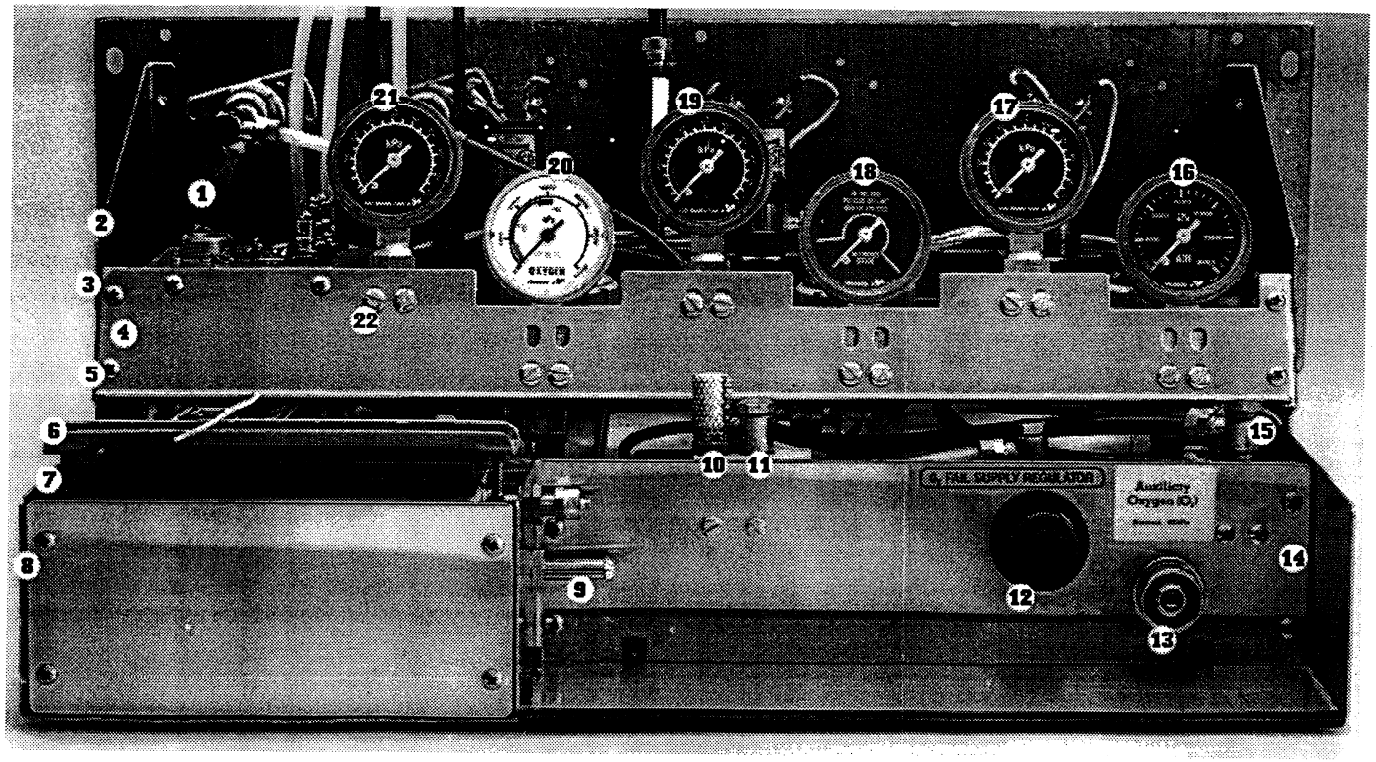
NEW RELEASE GQ0696/1 24/10/91


DETAIL A
MAXIMUM TOTAL LOAD ON OUTLETS 2280 WATT/9.5 AMP
THESE OUTLETS MUST ONLY BE USED FOR EQUIPMENT ACTUALLY MOUNTED ON THE ANAESTHETIC MACHINE
CUMULATIVE EARTH LEAKAGE CURRENTS SHOULD BE MONITORED FOR EACH NEW PIECE OF EQUIPMENT ADDED
240 volt
50 Hz
10 AMP
SECURE CABLE TIE (ITEM 28) TO WIRES (ITEMS 5 & 6).
WHITE WIRES
BLUE WIRE
BROWN WIRE
GREEN/YELLOW WIRE
REFER DETAIL A
RED
BLACK
GREEN/YELLOW
GREN/YELL

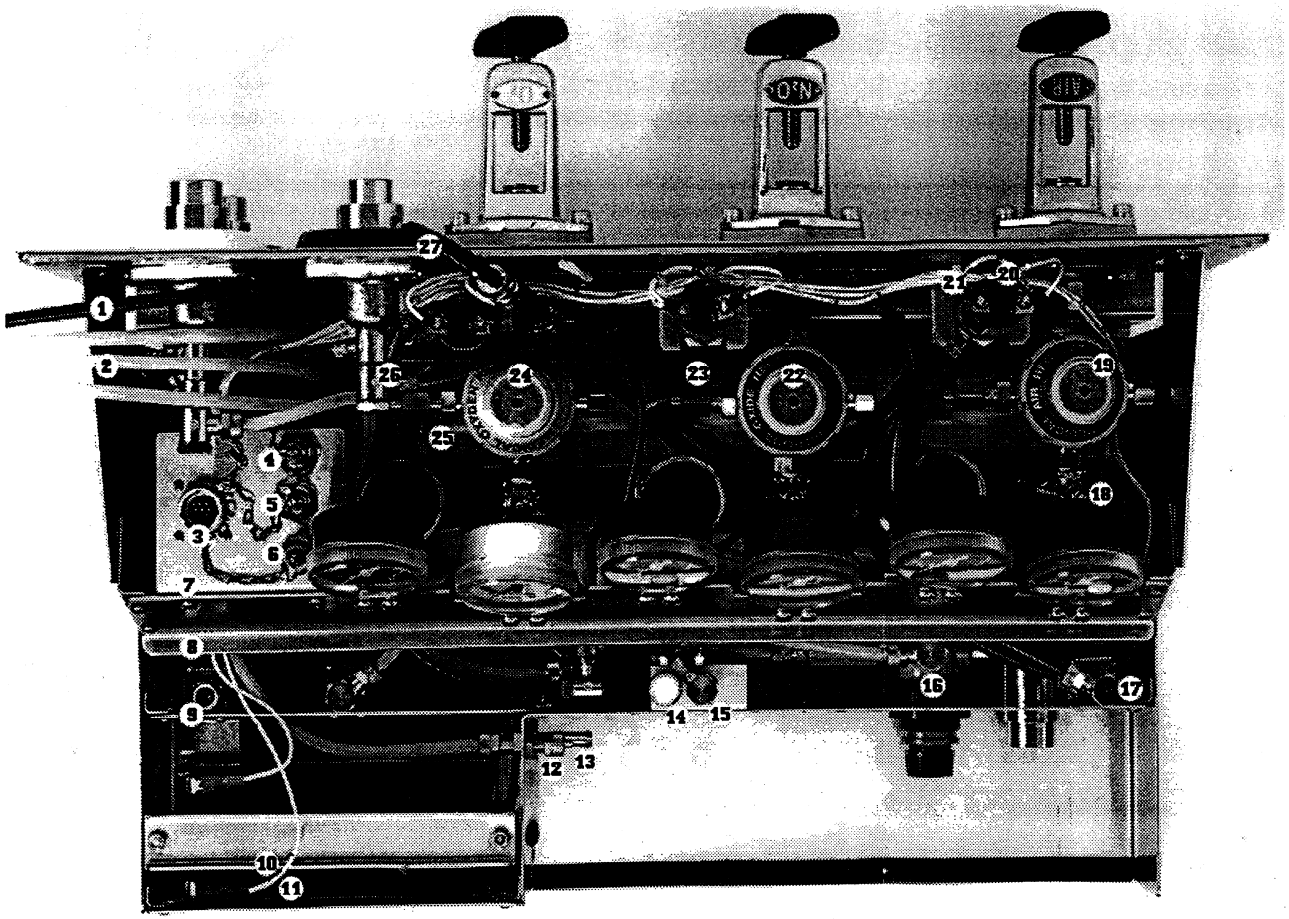
POWER BOARD ASSEMBLY



© Copyright 1993 – Iss/Rev A/0 –



© Copyright 1993 – Iss/Rev A/0 –



© Copyright 1993 – Iss/Rev A/0 –

8.0 General

8.1 Fault Finding

8.1 A Performance Matrix (Pneumatics)

8.1 B Performance flow chart - block diagram (Fig. 11)

8.1 C Problem Cause/Check Remedy List

Warning: Do not use a damaged or malfunctioning Anaesthesia System, patient injury could result.

Warning: Unqualified personnel must not attempt to undertake repair procedures.

Event	Possible Fault/Check	Remedy
Leak - Pipeline	Leaking hose connection	Replace "O" Rings on hose handwheel nipple
Leak - Pipeline	Damaged/Faulty Pressure Hose	Replace Pressure Hose Assembly
Leak - Cylinder	Leaking Cylinder Valve	Renew Cylinder
Leak - Cylinder	Leaking Bodok Seal	Replace Bodok Seal
Leak - Pipeline Pressure Gauge	Leaking/Faulty Bordon Tube in Gauge	Replace Gauge - Service Call
Leak - Cylinder Pressure Gauge	Leaking/Faulty Bordon Tube in Gauge	Replace Gauge - Service Call
Pipeline Pressure Gauge not working	Machine not connected to pipeline gas supply	Connect to pipeline gas supply
	Faulty Gauge	Replace Gauge - Service Call
	Faulty Gauge	Check pipeline warning system

© Copyright 1993 – Iss/Rev A/0 –

Event	Possible Fault/Check	Remedy
Cylinder Pressure Gauge not working	Cylinder Valve turned OFF.	Turn Cylinder Valve ON.
	Cylinder Empty	Replace with FULL Cylinder
	Faulty Gauge	Replace Gauge - Service Call.
Gauges indicate a drop in pressure.	If all of the above "remedy to leaks" fails to correct leak, machine internal pneumatics is now the cause.	Internal Gas Module leak - Service Call
Oxygen Failure Warning Device Pneumatic Failsafe System) does not operate to specification.	Cut in pressure. Out of adjustment.	Service Call. Service Call.
	Other Gases do not cut off.	Service Call.
	Gases do cut off but no whistle present.	Service Call
On-Off Switch turned ON - nothing operates	Machine not connected to mains or turned OFF at mains.	Connect to mains and turn ON.
	Mains not available - back-up battery flat.	Connect to mains and recharge battery.
No gas flow at rotameter.	System On-Off switch in the OFF position.	Turn system On-Off switch ON.
	Faulty or jammed flow control valve.	Free jammed valve. Replace faulty Valve - Service Call.
	Gas Solenoid not opening.	Machine not turned ON. Faulty solenoid - Service Call.
Rotameter Bobbins not spinning or not spinning freely.	Dirty bobbin or tube.	Clean bobbin and tube - Service Call.
Leak in Back Bar Manifold. (No vaporisers fitted.	Self sealing valves inside Back Bar Manifold leaking	Replace internal "O" Rings or valve Service Call.

Event	Possible Fault/Check	Remedy
Leak in Back Bar Manifold (Vaporisers fitted)	Vaporiser(s) not seated correctly on Back Bar. Vaporiser(s) locking device not in the locked position. Leaking "O" Rings on Back Bar Manifold "O" Ring(s) missing from Back Bar Manifold.	Remove vaporiser(s) and refit to Back Bar Turn locking device to the LOCKED position Replace "O" Rings. Replace "O" Ring(s)
Vaporiser Dial Control stiff.	Build up of Thymol Lack of routine service.	Service vaporiser. Service vaporiser.
Vaporiser leaking agent.	Seals on filling port damaged. Pin indexed filling adaptor faulty.	Service vaporiser. Replace.
Oxygen Flush Valve leaking (slow).	Faulty or sticking flow valve, will not seat correctly.	Fit new seat kit - Service Call.
Oxygen Flush Valve leaking (fast).	Flow Valve has stuck in the open position.	Fit new seat kit - Service Call.
50 cm H2O Patient Safety Valve activated High or Low.	Vents occluded. Manual override jammed closed. Faulty spring tension (no longer within specification	Unblock occlusion. Check and/or replace. Fit new valve kit - Service Call.
Fails Oxygen Analyser Qualitative Test	Oxygen Analyser not correctly calibrated. Wrong gas in pipeline or cylinder Possible crossed pneumatic circuit connection.	Calibrate Oxygen Analyser. Confirm correct gas is present at source. Quarantine machine - Service Call.

© Copyright 1993 – Iss/Rev A/0 –

8.2 Preventative Maintenance

Test	3 months	6 months	12 months	REF
Gas Hoses	✔	✔	✔	6.1
Frame & Casters	✔	✔	✔	6.2
Battery Replacement			3 Yrly	Nil
O_2 Gas Block - Yoke	✔	✔	✔	6.3
- Relief Vale			✔	6.4B
- Non-Return Valves V1 & V4		✔	✔	6.4C
- Reg Press R1		✔	✔	6.4D
- Non-Return Valve V8			✔	6.5
- O2 System Leak		✔	✔	6.5
- On/Off Control			✔	6.6
- PS1			✔	6.7
- O2 Fail Reg R4			✔	6.8
- Power Outlet			✔	6.8A Book
N_2O Gas Block - Yoke	✔	✔	✔	6.3
- Relief Valve			✔	6.4B
- Non-Return Valves V2 & V5		✔	✔	6.4C
- Reg Press R2		✔	✔	6.4D
- N2O System Leak		✔	✔	6.9
- PS2			✔	7.1
Air Gas Block -Yoke	✔	✔	✔	6.3
- Relief Valve			✔	6.4B
- Non-Return Valves V3 & V6		✔	✔	6.4C
- Reg Press R3		✔	✔	6.4D
- Air System Leak		✔	✔	7.2
- PS3			✔	7.3
O_2 Failure System Functional	✔	✔	✔	7.4
AC & DC Power Failure Alarm Sol 1		✔	✔	7.5
Flowmeter Unit - Functional	✔	✔	✔	
- Major Service			✔	
- Lights			✔	
Vaporiser Manifold-'O' Ring Replacement	✔	✔	✔	6.5 Book
- Sealing Tests		✔	✔	
GMS 125 - % Comparison		✔	✔	6.11 Book
- Alarm Functions	✔	✔	✔	100
O_2 Flush Valve		✔	✔	6.7 Book
Safety Valve	✔	✔	✔	6.6 Book
GPO Sockets		✔	✔	110
Electrical Safety Tests		✔	✔	110
Accessories -As Fitted	✔	✔	✔	

8.3 Anaesthesia System Inspection Form

Note: All gases must be turned OFF before turning the Anaesthesia System ON.

Hypoxic Monitor/Rotameter Module

Test	Component/System	Pass	Fail	Pressure Adjusted from kPa	Pressure Adjusted to kPa	Rotameter Backlight ON	Rotameter OFF	Display Reading Backlight 30 Secs.	Hypoxic Alarm after Point	Set Comments
1.	Gas Failure Alarm - Oxy - N_2O - Air									
2.	Mute Switch - Oxy N_2O - Air									
3.	Visual Display: - Oxy Gas Failure Alarm - N_2O - Air									
4.	Turn ON Oxygen (Gas Flow - OK)									
5.	Turn ON Air (Gas Flow - OK)									
6.	Set Oxy Flow to 1 lpm - Wait 30 seconds Display should read 100%									
7.	Turn ON N_2O (Gas Flow - OK)									
8.	Set N_2O Flow to 2 lpm - (Reduce Oxygen to 1/2 lpm) Hypoxic Alarm should activate at set point. Oxygen should read 20% within 30 seconds.									
9.	Alarm Reset (automatic) Turn OFF N_2O flow completely, Oxygen flow to 1/2 lpm - Oxygen should read 100% within 30 sec.									
10.	Turn ON Air (Gas Flow OK)									
11.	Set Air Flow to 2 lpm - Oxygen flow at zero. Display should read 21% within 30 seconds.									
12.	Pneumatic Failsafe Valve									

© Copyright 1993 – Iss/Rev A/0 –

8.4 Breathing Systems

GEM™9100 is supplied with a sliding fresh gas outlet and this can be considered as the start of the patient circuit. The external diameter is 22 mm male and 15 mm female internal diameter.

A latching bayonet connection is provided to help prevent any accidental disconnection and to provide a secure leak tight connection.

Breathing Systems or patient circuits that can be used on GEM™9100 would fall into the following categories:

- Closed circuit, e.g. circle absorber
- Semi closed circuit, e.g. Magill (Mapleson A)
- Open circuit, e.g. Jackson Rees T piece
- Co-axial circuit, e.g. Bain or Lack

CIG Health Care offers a range of products to suit most requirements and a comprehensive catalogue is available on request.

As a guide, the ideal patient circuit should have the following properties:

1. Low inspiratory and expiratory effort for spontaneous breathing
2. Identifiable as disposable or reusable
3. Easily sterilised/cleaned
4. Easily handled and light weight
5. High tolerance to fresh gas flow rate - economical
6. Low pollution of the environment
7. Low dead space
8. Corrugated tube not kinkable
9. Length appropriate to type
10. Fittings not susceptible to distortion
11. Anti static (where appropriate)
12. Cost effective

8.5 Pre-Operative Checkout and System Shutdown

Warning: Do not begin use of the GEM9100™ without verifying its correct operation and the correct operation of all associated accessory and optional equipment. Pre-operative check should be performed before each case and in the room having the pipeline supply and electrical sources to be used for that case.

These checkout procedures are applicable to the GEM9100™ only. If the System does not function according to the following procedures, call your local CIG Health Care office or a CIG Health Care Authorised Distributor.

This checkout procedure is designed to be followed sequentially. If the sequence is interrupted it should recommence at step 8.1.

Instructions Highlighted **INDICATE ACTION BY OPERATOR.**

8.6 Drain and Prepare

Ensure all gas supplies are off and drained from machine. To drain gases:

1. Ensure oxygen supply and ON/OFF switch are both turned ON.
2. Turn off and disconnect all nitrous oxide and air supplies, set O_2 flow to 3 lpm.
3. Open nitrous oxide rotameter knob and bleed until no flow is indicated on nitrous oxide rotameter.
4. Select air. Repeat step 3 for air.
5. Turn off and disconnect all oxygen supplies.
6. Open oxygen rotameter knob and bleed until no flow is indicated on oxygen rotameter.
7. Turn OFF main ON/OFF switch.

8.7 Gas Monitoring System Test

Turn ON the main ON/OFF switch.

The GMS monitor will self test, all lights should light and alarm sound.
After the self test, the O_2 failure alarm should be initiated both visually and audible.

Push the mute/reset button. The audible alarm should silence and resound after 15 seconds.

8.8 Check Gas Supplies

Connect all pipeline gas supplies and check they are available.

Open all cylinder valves and after 10 seconds close them. A falling gauge indicator shows a leak. Replace O_2 cylinder if less than 1/4 full.

8.14 Breathing, scavenging and other system should be checked as per ANZCA's protocol.

8.15 System shut down

Leave ON/OFF switch ON.
Turn off all cylinders.
Disconnect pipeline supplies from wall outlets.
Bleed all gases from system.
Turn machine off.
Leave machine connected to mains to keep battery charged.

Operational Note 3

When changing from oxygen/nitrous oxide to oxygen/air a transient system error alarm may occur. This is caused by an inversion layer of N_2O moving down the measurement chamber. The condition will automatically clear and display revert to normal when the chamber is flooded with the new gas mixture of oxygen/air - typically approximately 30 seconds.

F Flowmeters

1. Ensure that the bobbin moves freely.
2. Turn OFF each flowmeter control (fully clockwise) and check that the position of the bobbin is at zero and that no gas flows.

G Vaporisers

1. Check each vaporiser in turn.
   - 1.1 That it is seated correctly and locked in place and will not lift off the back bar.
   - 1.2 That it can be turned on.
   - 1.3 That it is turned off.
   - 1.4 That it contains a sufficient amount of the correct liquid agent.
   - 1.5 That the filling and emptying ports are fully closed.

H Test for Leaks Upstream of the Common Gas Outlet

1. Connect a pressure manometer to the fresh gas outlet.
2. Turn ON the oxygen flowmeter control carefully to 100 ml/minute.
   - 2.1 A gas flow of 100 ml/minute should maintain a pressure of 40 cm H2O, i.e. there are no significant gas leaks.
   - 2.2 If a greater gas flow is required to maintain this pressure, the magnitude of the flow indicates the extent of the leak.
   - 2.3 The function of the safety precircuit pressure release valve may be checked by gradually increasing the gas flow until pressure release occurs.
3. Repeat this test with each vaporiser turned "OFF" and "ON" in turn.

I Breathing System Selection

1. Check that the gas supply is connected to the selected breathing systems.
2. Check that the size of tube used to make this connection is adequate to cope with anticipated gas flows. High gas flows require a larger diameter.

J Circle Absorption System

1. Soda lime - check that this is not exhausted. Renew if necessary, and remove dust from soda lime when refilling canister.
2. Breathing hoses - check that these are correctly and firmly connected.
3. Valve function and leaks in breathing system

4. Close adjustable pressure relief valve and attach spare breathing bag to the patient connection limb of the "Y" piece.
5. Depress the oxygen flush button to fill the breathing bag.
6. Alternately squeeze the two bags to ensure that oxygen passes from one bag to the other, and check visually that each unidirectional valve functions correctly.
7. Squeeze both bags simultaneously to raise the pressure in the circuit to approximately 30 cm water.
8. Open spill valve and check that gas spills easily when both bags are squeezed.
9. Disconnect spare breathing bag and replace with a mask suitable for the patient.

K Scavenging System

1. Check that the scavenging circuit is connected correctly to the selected breathing system.
2. Check that all components of the scavenging system are unencumbered to allow free gas flow.
3. If negative pressure is used to aid scavenging check that this does not empty the breathing system.
   - 3.1 Fill the breathing system with oxygen by occluding the patient outlet and depressing the oxygen flush button.
   - 3.2 Check that the circuit does not empty when the spill valve is opened.
   - 3.3 Close the spill valve again when this check has been done.

L Apparatus Mounted on the Anaesthetic Machine

1. Other apparatus to be used in the conduct of the anaesthetic should be checked according to the protocol appropriate to the device.
2. Special attention should be given to:
   - 2.1 Equipment for intubation of the trachea.
   - 2.2 Suction apparatus.
   - 2.3 Ventilators.
   - 2.4 Gas analysis devices.
   - 2.5 Disconnection alarms.

M System Shutdown

1. Leave machine turned ON.
2. Turn OFF all cylinders.
3. Disconnect pipeline supply hoses from wall outlets.
4. Bleed all gases from system.
5. Turn machine OFF.
6. Leave machine connected to mains to keep battery charged. (A "Mains Off" alarm will warn if mains is disconnected).

© Copyright 1993 – Iss/Rev A/0 –

1. Tube Red CIG7970276
2. Tube White CIG7970277
3. Plug c/w Loom CIG512630
4. O/A Valve Air CIG798069
5. O/A Valve O_2 CIG798068
6. O/A Valve N_2O CIG798067
7. Plate Mounting CIG512634
8. Plate CIG512593
9. Sol Switch (3) CIG7973726
10. Bat Bracket CIG512624
11. Battery CIG7995265
12. Conn FGO c/w Nut CIG7968060
13. Nut CIG512602
    Connection Tube/FGO CIG512601
14. Shuttle Valve CIG7973725
15. Banjo N_2O
    Sleeve CIG7968054
    Bolt CIG7968057
    Washer CIG7968074
16. Banjo O_2
    Sleeve CIG7968055
    Bolt CIG7968057
    Washer CIG7968074
17. Banjo Air
    Sleeve CIG7968056
    Bolt CIG7968058
    Washer CIG7968074
18. Valve, Test Point
    Air CIG7968085
    N_2O CIG7968086
    O_2 CIG7968087
19. Regulator Air CIG512262
20. Pressure Switch (3) CIG7937724
21. Bracket CIG512597
22. Regulator N_2O CIG519260
23. Connection HP (3) CIG512628
24. Regulator O_2 CIG519261
25. Reservoir c/w Connections CIG512588
26. Tube Blue CIG7970278
27. Tube Black CIG7970275

1. Non Return Val CIG7968063
2. Bracket LH CIG512682
   Bracket RH CIG512681
3. Whistle CIG7968062
4. Panel
5. Screw CIG7950235
6. Bracket
7. Battery
8. Panel CIG512631
9. Connection Tube/FGO CIG512601
10. Filter CIG7968081
11. Banjo
12. Reg Norgren CIG512258
13. Outlet Complete CIG518301
    Slide Valve CIGZP1135
    'O' Ring CIG7964100
    'O' Ring CIG7964026
    Sleeve O_2 CIGZP1156
14. Panel CIG512603
15. Banjo
16. Gauge CIG519137
17. Gauge LP CIG519258
18. Gauge HP CIG519136
19. Gauge LP CIG519258
20. Gauge HP CIG519136
21. Gauge LP CIG519258
22. Block Mount LP CIG512595

1. Spacer (3) CIG312504
2. Bodok Seal CIGOBM370000
3. Air Yoke CIG512648
4. Wing Screw CIGBA296
5. Screw CIG7950238
6. Panel CIG512528
7. N_2O Yoke CIG512642
8. Filter CIGRB39
   Connector m/m CIG512638
   Connector m/f CIG519244
   Screw CIGM609
9. O_2 Yoke CIG512641
10. Val 1st Fix O_2 CIG519297
    Val 2nd Fix O_2 CIG519184
    Plunger O_2 CIG518686
    'O' ring CIG7964100
11. Val 1st Fix Air CIG519299
    Val 2nd Fix Air CIG519185
12. Val 1st Fix O_2 CIG519297
    Val 2nd Fix O_2 CIG519183
13. Val 1st Fix N_2O CIG519298
    Val 2nd Fix N_2O CIG519186

GEM™9100 ANAESTHETIC APPARATUS

Item No: 512500

LV	Pref	Component Item No.	Description	Quantity Per Assembly	UM	Item Type	P H
03	1	512475	Body Block Fresh Gas	1.00000	Ea	2	
03	2	512501	Connection Outlet Assy	1.00000	Ea	1	P
03	3	512517	Tube Guard Fresh Gas	1.00000	Ea	2	
03	4	512477	Nipple Fresh Gas	1.00000	Ea	2	
03	5	512314	Nameplate Emergency Oxy	1.00000	Ea	4	
03	6	BA258	Button	1.00000	Ea	2	
03	7	512606	Nut Locking - Press Button	1.00000	Ea	2	
03	8	BA257	Spindle	1.00000	Ea	2	
03	9	BA270	Washer	1.00000	Ea	2	
03	10	7964001	O-Ring 006 Neop 65/75	1.00000	Ea	4	
03	11	512497	Valve Body	1.00000	Ea	2	
03	12	7968003	Valve Schraeder B500 Short	1.00000	Ea	4	
03	13	7964026	O'Ring 111 Neop 65/75	2.00000	Ea	4	
03	14	WL32	Spring 9DX14 STST	2.00000	Ea	4	
03	15	511848	Cap Relief	1.00000	Ea	2	
03	16	511846	Button	1.00000	Ea	2	
03	17	511849	Screw	1.00000	Ea	2	
03	18	511851	Spring SDX 18 Set	1.00000	Ea	4	
03	19	511847	Body	1.00000	Ea	2	
03	20	7964033	O-Ring 114 Neop 65/75	1.00000	Ea	4	
03	21	OBM311889	Seating	1.00000	Ea	4	
03	22	511941	Valve Assy Dished	1.00000	Ea	9	P

Item Parts List

GEM™9100 ANAESTHETIC APPARATUS

Item No: 512500

LV	Component Pref	Item No.	Description	Quantity Per Assembly	UM	Item Type	P H
02	1	512518	Back Bar GEM™9100	1.00000	Ea	2	
02	2	7950214	Screw Pan Hd M2.5X8 N PL	4.00000	Ea	4	
02	3	7950066	Screw Pan Hd M3 X 5	6.00000	Ea	4	
02	4	512332	Rest Nylon Backbar	2.00000	Ea	2	
02	5	7962019	Rivet Pop 3/16 73STS6-2	3.00000	Ea	4	
02	6	7958047	Nut MSBR M2.5 Zinc Pl	4.00000	Ea	4	
02	7	512349	Spring Retaining Dzus	2.00000	Ea	4	
02	8	7964030	O-Ring ...Neop 65/75	4.00000	Ea	4	
02	9	512355	Valve Assembly Backbar	4.00000	Ea	1	
02	10	7968043	Nut Tubing 1/4 OD	10.00000	Ea	4	
02	11	512350	Push On Fix 4.8mm	2.00000	Ea	4	
02	12	7970276	Hose Red Nylong 1/4" OD	1.70000	ME	4	
02	13	7968042	Sleeve Tubing 1/4 OD	9.00000	Ea	4	
02	14	7970279	Grommet Rubber S ID G83	1.00000	Ea	4	
02	15	512534	Label Backbar	1.00000	Ea	2	

Item Parts List

Item Parts List

GEM™9100 ANAESTHETIC APPARATUS

Item No: 512500

LV	Pref	Component Item No.	Description	Quantity Per Assembly	UM	Item Type	P H
03	1	512574	Assy Housing/Seat 8mm Air	1.00000	Ea	1	P
03	2	7964105	O-Ring 012 Neop 65/75	2.00000	Ea	4	
03	3	512573	Spindle Rotameter	1.00000	Ea	2	
03	4	FJ300	Nut	1.00000	Ea	2	
03	4	FJ301	Nut Gland	1.00000	EA	2	
03	6	515839	Knob F/Control Air/Ind	1.00000	Ea	2	
03	7	515811	Roll Pin Knob Flowmeter	1.00000	Ea	4	
03	8	521993	Label Air Rotameter Assy	1.00000	Ea	4	

Item Parts List

GEM™9100 ANAESTHETIC APPARATUS

Item No: 512500

LV	Pref	Component Item No.	Description	Quantity Per Assembly	UM	Item Type	P H
02	1	512509	Block Bottom Rotameter	1.00000	Ea	2	
02	2	512512	Side Plate Rotameter	2.00000	Ea	2	
02	3	NB355	Screw Csk 1/8BSWX1/4Cad	12.00000	Ea	4	
02	4	512566	Body/Flush Nut Assy	1.00000	Ea	1	P
02	5	7968061	Fitting Enots 94-1114-10	1,00000	Ea	4	
02	6	512567	Plug/Block Assy	1.00000	Ea	1	P
02	7	512503	Cover Plate Rotameter	1.00000	Ea	4	
02	8	521987	Label Rotameter Assembly	1.00000	Ea	4	
02	9	512577	Assy Control Valve Air	1.00000	EA	1	P
02	10	512579	Assy Control Valve N20	1.00000	Ea	1	P
02	11	512578	Assy Control Valve Oxy	1.00000	Ea	1	P
02	12	7962020	Canoe Clip 13-096-0015	4.00000	Ea	4	
02	13	OBM350573	Washer P/Ethylene ID15.8	6.00000	Ea	4	
02	14	OBM350432	Shr OBM350532 Unting	3.00000	Ea	4	
02	15	512580	Tube Index 02 Assy	1.00000	Ea	1	P
02	16	512581	Tube Index N20 Assy.	1.00000	Ea 1	P	
02	17	512582	Tube Index Air Assy	1.00000	Ea	1	P
02	18	OBM350433	Rubber Tube Mounting	3.00000	Ea	4	
02	20	OBM96664	Waher rubber	3.00000	Ea	4	
02	21	512508	Light Diffuser Rotameter	3.00000	Ea	4	
281-02	22	512585	Light Panel Assy Rotameter	3.00000	Ea	4	
02	23	OBM550575	Filtered Disc	3.00000	Ea	4	
02	24	512513	Locknut Spindle Housing	3.00000	Ea	2	

LV	Pref	Component Item No.	Description	Quantity Per Assembly	UM	Item Type	P H
01	44	512547	Block Mounting Bracket	4.00000	Ea	2	
01	45	512482	Bracket Brake Assy R/H	1.00000	Ea	4	
01	46	512538	Castor Front GEM™9100	2.00000	Ea	4	
01	47	512627	Electrical Outlet Assy	1.00000	Ea	1	
01	48	7950233	Screw Pan Hd 8ADX3.8 STST	6.00000	Ea	4	
01	49	7958054	Nut Spire 8AB 1675/17/4	6.00000	Ea	4	
01	50	512600	Module Pneumatic GEM™9100	1.00000	Ea	1	P
01	51	512555	Nut Retaining Knurler	6.00000	Ea	2	
01	52	7970280	Extrusion Jehbsil 671	0.40000	Me	3	
01	53	512681	Cover Plate Side R/H	1.00000	Ea	2	
01	54	512657	Bracket Suction GEM™9100	1.00000	Ea	4	
01	55	7995267	Cap Champ Flag Grip P781	2.00000	Ea	4	
01	56	512539	Castor Rear GEM™9100	2.00000	Ea	4	
01	57	521966	Carton 5 Items GEM™9100	1.00000	Ea	4	
01	58	522008	Manual GEM™9100 CMP524768	1.00000	Ea	4	
01	60	521731	Bag Plastic GEM™9100 Explosion Finished	1.00000	Ea	4	
01	61	KP1053	Grommet 9mmID 15mmOD	2.00000	Ea	4	
01	62	512686	Spacer Mounting Rotameter	4.00000	Ea	2	